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# Experimental Psychology Monographs

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**VARIATIONS IN THE GRADES OF HIGH  
SCHOOL PUPILS**





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**Educational Psychology Monographs**

**Edited by Guy Montrose Whipple**

**No. 8**

**Variations in the Grades of  
High School Pupils**

**By**

**CLARENCE TRUMAN GRAY, A. M.**

**Instructor in the Department of Education,  
University of Texas.**



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## EDITOR'S PREFACE.

Ten years ago no serious attempt had been made to study scientifically the relative merits of various systems of grading students, despite the fact that statistical methods for undertaking such studies were fully available and that grading plays so large a rôle in the school career of hundreds of thousands of school children. In the last five years, however, this inviting field has been the scene of numerous important investigations, so that we have at least arrived at a better understanding of the nature of the problem and of the general line along which progress must be made.

In the present monograph, Mr. Gray reports the methods and results of his investigation of one phase of the general problem, viz: the nature, degree and causes of the variations occurring in the grades of high-school pupils. His work should interest all teachers and more particularly all school administrators, because he not only shows clearly how unreliable are the grades commonly given by teachers and makes evident the need of instruction and training in grading, but also presents a relatively simple method by means of which any high-school principal can study the condition of the grading in his own school and take due steps to remedy the faults that he may find.

It is hoped that this monograph may be followed in the near future by one or more other studies of the distribution of grades.

G. M. W.



## **AUTHOR'S PREFACE.**

The general and specific purposes of the monograph are stated in the first few pages. The methods used are similar to those used by Ayres, Dearborn and Thorndike. One great value of this type of investigation is that it raises as many problems as it solves. Attention has been called to a number of these problems at various points in the text.

The work was done at Chicago University under the direction of Dr. C. H. Judd, Director of the School of Education, and Dr. W. F. Dearborn, Professor of Education. To these men I owe the greatest debt of gratitude, for without their sympathy and assistance the investigation could not have been made.

I acknowledge very gratefully valuable suggestions upon method from Mr. Walter P. Morgan of Englewood High School, Chicago, and the indispensable aid given me by those principals and superintendents from whose schools the material was secured.

Much credit is also due my wife, Bessie Stretcher Gray, for her help upon the clerical work which it was necessary to do in order to get the results.

C. T. GRAY.

Austin, Texas, July, 1912.



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## INTRODUCTORY.

The general aim of this study is to base an educational investigation upon school grades. Students of education have been very slow to enter this field for material in their studies. It is usually argued that such marks are inaccurate, that they are complex, that they are not scientific, and above all that it is impossible to measure mental traits by such cold statistics as grades afford. In direct contrast to these arguments stands the fact that all promotions from the kindergarten through the university are based upon these so-called inaccurate, complex, unscientific and cold estimates of progress and achievement. One of the most vital and fundamental principles of any school system is its plan of promotions, and because of the close relation between promotions and grades there is the most urgent need that schoolmen become interested in the problems of grading. In this connection Professor Cattell says,\* "In examination and grades which attempt to determine individual differences and to select individuals for special purposes, it seems strange that no scientific

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\*See bibliography at end of the book for list of references on the problems of grading.

study of any consequence has been made to determine the validity of our methods, to standardize and improve them. It is quite possible that the assigning of grades to school children and college students as a kind of reward or punishment is useless or worse. Its value could and should be determined. But when students are excluded from college because they do not secure a certain grade in a written examination or when candidates for positions in government service are selected as a result of a written examination, we assume a serious responsibility. The least that we can do is to make a scientific study of our methods and results."

If we grant the arguments against such material, the need for such investigations is made the more apparent because the only way that these faults and limitations in our grading system can be remedied is by such scientific study as will reveal just where these defects are. Then suggestions can be made intelligently.

One of Professor Dearborn's strong arguments for this type of investigation is that all grades may be considered the records of school experiments. He says, "In arguing for the school experiment the writer would not have it forgotten that in existing school records and reports and in present school practices there is already accumulated or available a body of data which, if properly evaluated, just as truly represents the results of experimental investigation as new experiments might do. School practices always represent great educational experiments."\*

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\**School Review Monographs*, No. 1.

Similarly, Dr. Clement remarks: "When marks are recorded in a complete, accurate and intelligent manner, and when they cover a series of years, they furnish one important means among many of evaluating a school system. Let it be clear that it may not be the only means. But since marks have been used and are now used, they furnish one clue to the efficiency both of individuals and of institutions."†

Another phase of this matter which cannot be too strongly emphasized is the form and filing of school records. In one or two places where the writer went to get material it was so scattered and incomplete that it was worthless. In other places the records were kept in dingy and dusty store rooms in such form that to procure the needed data would have required an excessive expenditure of time. These conditions exist not because school officials are negligent, but because they have not seen the value of continuous school records. If they are convinced of their importance and practical value, conditions will immediately improve. On the other hand, it should be stated that in most places the grades were kept in bound volumes and were entirely accessible. In very few places, however, was any effort made to keep continuous, individual records. The record of a given pupil for a given year was in most cases entirely separate from his record for any other year. It was found, too, that records of attendance are considered of very little importance after a school term ends. In no case was any effort made in any way to associate the grades of a pupil with his attendance records. These remarks will serve to emphasize the

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†*Standardization of the Schools of Kansas*, page 4.

fact that we need to have some practical work done upon school records. As to just what the correct form is there is great difference of opinion, but the data should certainly be rendered more uniform, more complete and more continuous.

## **THE PROBLEM.**

The specific problem is concerned with the *relative standing* of pupils in the different years of the high-school curriculum, as indicated by their marks and grades. Suppose a pupil at the end of the first year has a mark of 80 points (per cent.), then our first problem is to determine whether this pupil's mark for the other three years remains near 80 points or goes up or down.

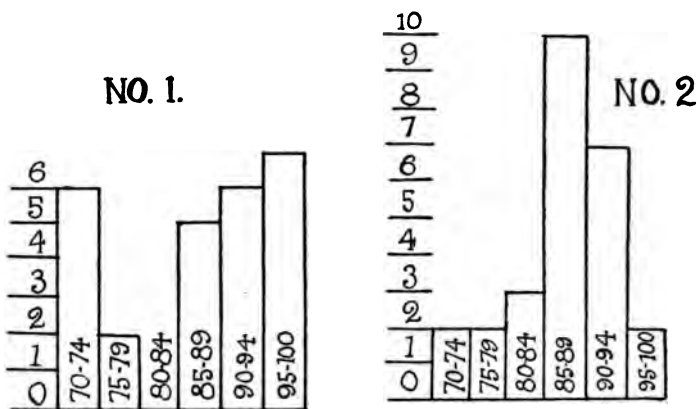
Again, we may give the problem a somewhat different turn by using relative position rather than points. If we divide any class into five equal parts, putting the highest grades in the first quintile, our problem will be to determine whether any given pupil does or does not remain in the same quintile throughout the four years.

## **REASONS FOR TAKING UP THIS PROBLEM.**

First, it is evident that by comparing grades of high-school students we shall procure data which will make possible the comparison of different departments in the same high school. If pupils in one department make a much greater variation than those in another, there ought to be some way of ex-

plaining the greater variation, or the variation should be reduced. For instance, in one school under investigation there is a department which shows an average variation of 6.2 points, in mathematics, while in another department there is only a variation of 3.2 points. Here, evidently, is a problem for the first department, because there is no obvious reason why pupils should make a higher variation in one subject than in another.

It is of interest to compare the grading of one department with that of another. The first graph below shows the distribution of grades of a class of twenty-five in first-year history. The second graph shows the distribution of grades of the same pupils in first-year English.



The altitude of any rectangle represents the number of pupils in that particular group. The grades range from 70 to 100, and are divided into six

groups, as shown by the numbers in each rectangle. Thus, in history there are six pupils in the group. 70-74, two in the group 75-79, and so on. It is evident that these two departments are marking in such a manner as to get a very different distribution of grades. The history grades run either high or low, while in English the majority of the class is put in the middle group.

The material is also of interest to us because it makes possible a comparison of the grades which a department gives to the same pupils from year to year. The graphs on pages 14-19 give such data for one of the high schools studied. The distribution of the English grades is especially interesting because of the large numbers placed in the lowest groups for the fourth year. Comparing the English with the Science, the graphs show that the policies of the two departments differ radically. The way in which the particular English department marks is probably related to the practice of a neighboring college which is very severe in its grading. There is certainly a problem here for the English department. Either their peculiar practice should be explained or it should be changed, for the natural expectation would be that classes would improve in the later years in a subject.

In collecting this material one principal was found who had used this same kind of data to assure himself that his teachers were using grades which meant the same to all. He submitted all the grades of a given pupil to all the instructors of that pupil. At first the teachers regarded the plan as a criticism, but later took it as a help and were eager to examine



PLATE 1.  
DISTRIBUTION OF ENGLISH GRADES FOR FIRST YEAR.

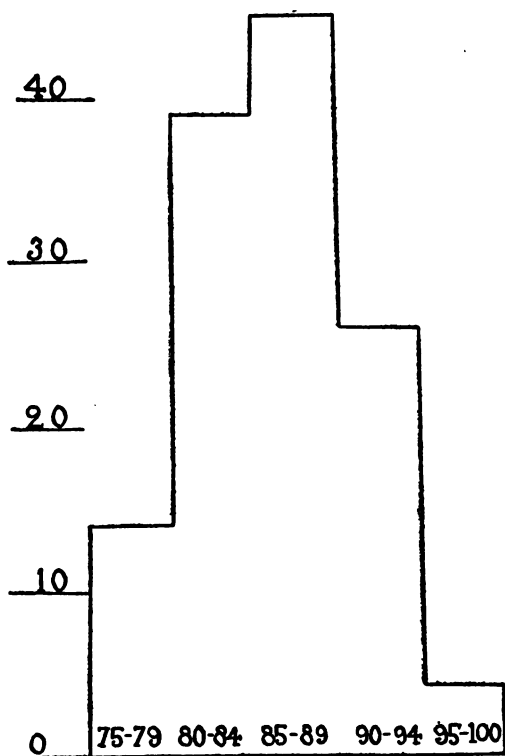


PLATE 2.  
DISTRIBUTION OF ENGLISH GRADES FOR SECOND YEAR.

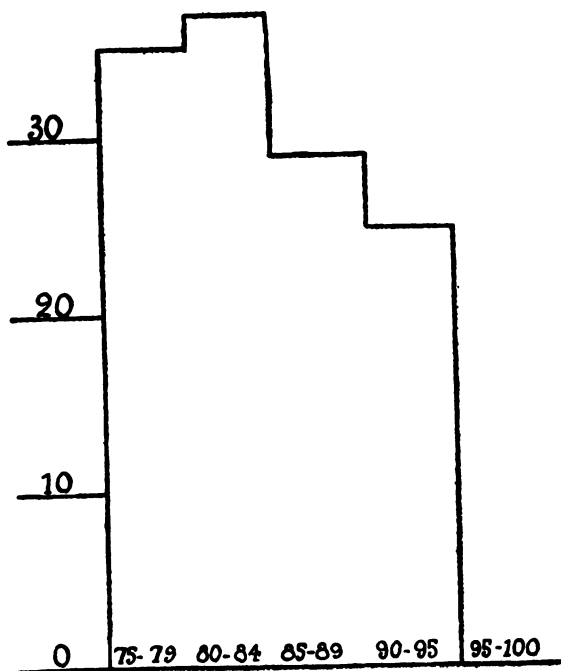


PLATE 3.  
DISTRIBUTION OF ENGLISH GRADES FOR THIRD YEAR

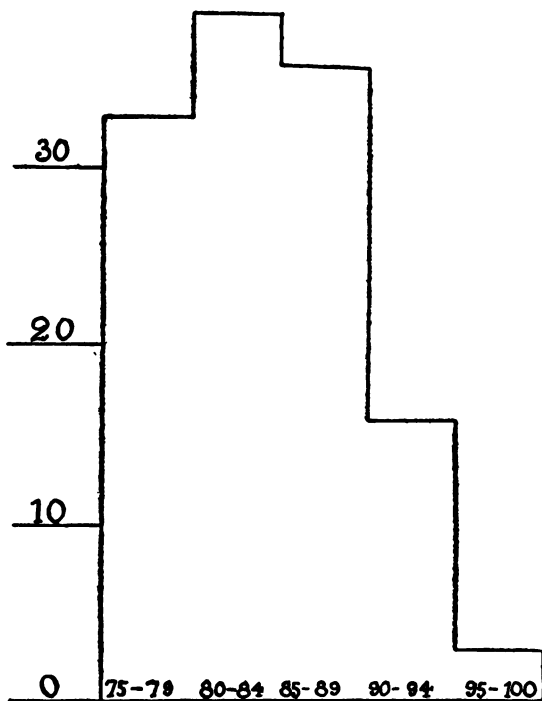
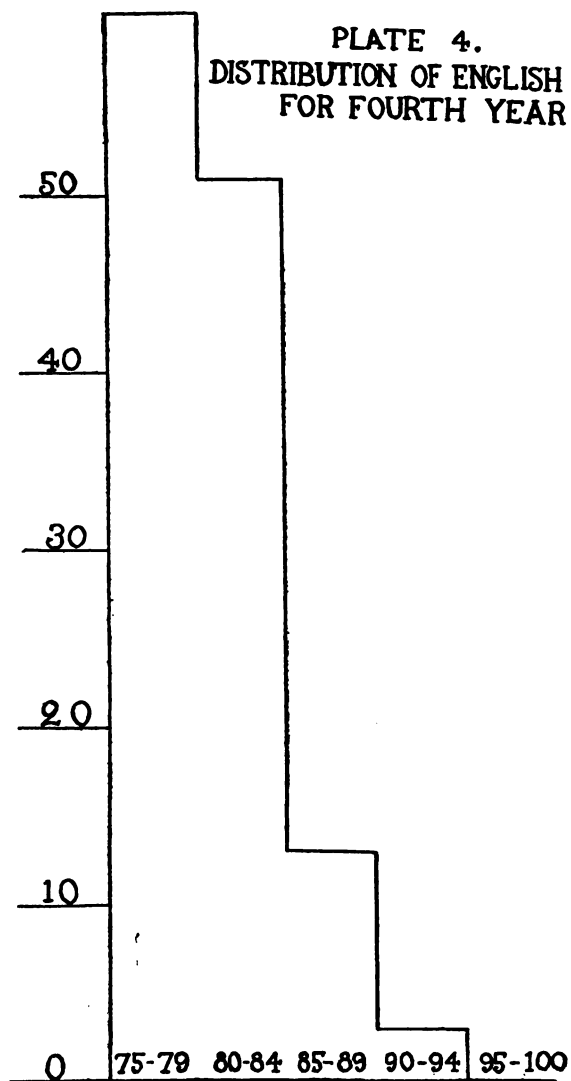


PLATE 4.  
DISTRIBUTION OF ENGLISH GRADES  
FOR FOURTH YEAR.



**PLATE 5.**  
**DISTRIBUTION OF GRADES IN THIRD YEAR SCIENCE.**

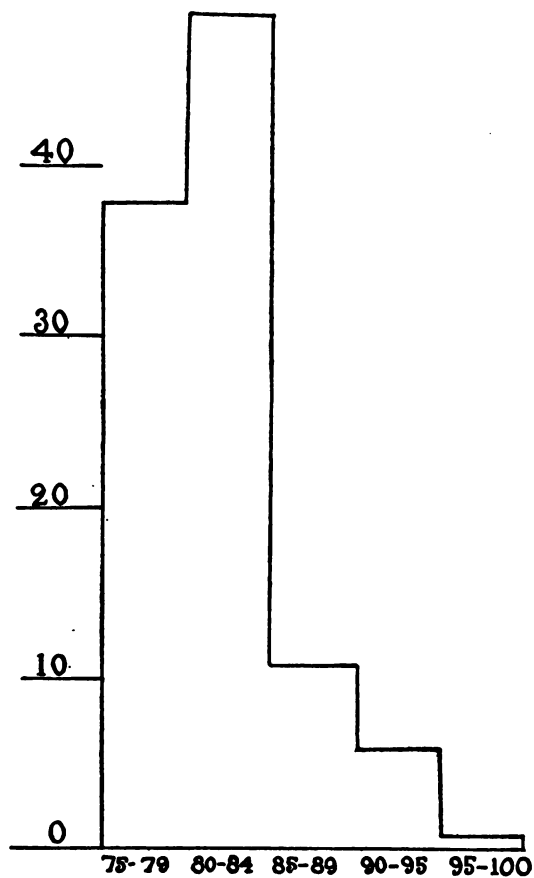
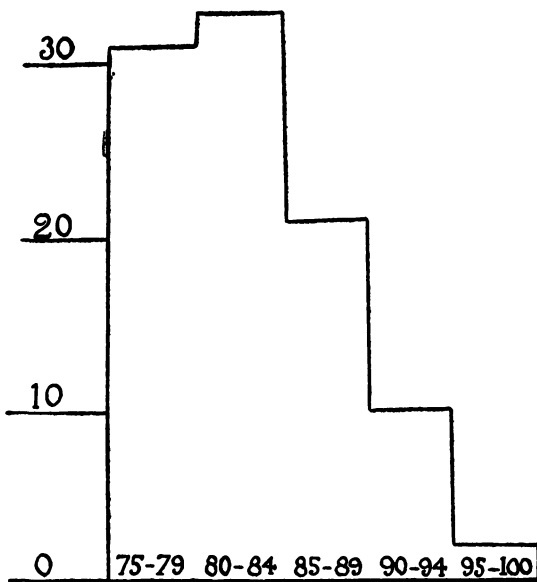


PLATE 6.  
DISTRIBUTION OF GRADES IN FOURTH YEAR SCIENCE.



the data, because if a pupil was making 95 in three departments and only 80 in the fourth, there was probably some reason for the low mark which the teacher could find out.

A further use to which a study of grades may be put can be described by calling attention to the fact that a principal can compare his high school with any college to which a number of his pupils go. To illustrate, suppose a principal has a graduating class of fifty. He can easily divide this class into quintiles, and so find the relative position of each pupil in any or all subjects. Then, if ten of this class, two from each quintile, enter the same college and join a class of one hundred, he can, at the end of the year, obtain the grades of the Freshman class in one or more subjects. He should divide this college class into quintiles; he then has a right to expect to find his pupils taking their respective places in these quintiles. If they have lost in position, either the college work is pitched too high or the high-school work is pitched too low.

Furthermore, not only can a high school be compared with a college, but through the college various high schools may be compared with each other. To compare one high school with other high schools represented in the college Freshman class it would be necessary to get the grades from all the high schools, so that the relative positions of the members of this college class in their respective high schools could be determined. If in any other high school as many pupils had lost in position as in the high school under consideration, then the principal could conclude that the college work was pitched too high for this enter-

ing class. While, on the other hand, if the majority of the pupils from this group of high schools held their positions when they reached the college, then the principal could feel sure that his own school was pitched too low, and his problem would be to raise his standard.

This same method of comparison by means of the college work can be used in the comparison of teachers, because, if the the pupils of one teacher exhibit little variation when they go to college, it is reasonably sure that they are working in the same way as the college, while if the pupils of another teacher exhibit wide variation in the direction of loss in position, then it is evident that the high-school work is not so conducted as to give adequate preparation. It might be argued that such variations as those mentioned above might be due to changes in subject-matter, or that the teacher does not have the ability to discriminate carefully in her grading. If this is true, the problem still exists just the same, and should be met.

It is true, too, that facts of this sort would be invaluable to university inspectors and State high-school inspectors, because the thing in which they are primarily interested is the quality and consistency of the work of each school under consideration. The present method of these inspectors is to get this knowledge by a day's visit and by general observation of the external affairs of the school, whereas, if they had at hand a quantity of such material collected through several years, they would have a much more rational basis from which to draw their conclusions.



In fact, the purpose of this work is to get at what may be called an internal analysis and comparison of high schools. This is better than mere reliance upon external characteristics, such as attendance, buildings, number of teachers, laboratories, etc., which have thus far supplied the basis for estimates of school efficiency.

## THE MATERIAL.

/ The grades used are from two of the public schools in Chicago and eight Indiana schools. The material from Indiana was procured at Indianapolis, Terre Haute, Elwood, Alexandria, Tipton, Oakland City, Madison and Spencer.

The schools in Chicago are two of the largest and best organized in the city. One of them is a large Manual Training School. Indianapolis and Terre Haute are cities which represent large business interests. In both places the high schools operate under good conditions. The remaining cities vary in population from three to fifteen thousand. While they have some manufacturing, they are for the most part in the midst of large agricultural districts, and have a large number of students from the country. With the exception of one of the smaller cities, all have good conditions for school work. The enrollment of these schools varies from one hundred and twenty-five to fifteen hundred. Almost any phase of high-school work which can be found anywhere can be found in some one of these schools, so that the material is certainly representative.

The grades used in most cases are the year-grades in English, History, Mathematics, Latin, Modern Languages and Science. The only exception is in the

case of the Manual Training School, where English, Drawing, Shop Work, Mathematics and Science were procured. In a few places the marks were in such a form as to make it impossible to get just what was wanted. For instance, in one place a mark was given each month, and at the end of a half-year a term-examination was required: no average was given, and because of the great labor required in computing averages the average of the marks for the first two months in the year was used as the year-grade for the first two years, and the average for the last two months was used as the year-grade for the last two years. In two places the grades were in letters, and these were transformed to points (per cents.) according to the key furnished by the principal. The grades for one school were gotten for each quarter in the year. By getting the grades of twenty-five pupils through the first year and twenty-five through the second, third and fourth years, there is the opportunity of finding what variations are made in any one year.

## THE METHOD.

In gathering the material cards were printed and filled out as is shown herewith:

Name or number 1

Second

High School.

		1st Year	2d Year	3d Year	4th Year	Gain	Loss	Pos. Bal.	Neg. Bal.	Total
English.....	Grade....	89	92	84	85	4	8	--	4	12
	Position..									
History .....	Grade....		85	83	82	--	3	--	3	3
	Position..									
Mathematics...	Grade....	88	84	80		--	8	--	8	8
	Position..									
Latin .....	Grade....	88	78	79	79	1	10	--	9	11
	Position..									
Modern Languages...	Grade....									
	Position..									
Science .....	Grade....	80			91	11	--	11	--	11
	Position..									

It will be noted that this pupil had four years of English, three years of mathematics, four years of Latin, two years of science and three years of history.

The grades in English usually included both the literature and the composition work. History included any history work done, and in some cases a half-year of civics. Mathematics means algebra, geometry, trigonometry, and in most of the Indiana schools a half-year of arithmetic. Modern languages includes both German and French. The greatest range of subjects is found in science. Included in it are physics, chemistry, botany, zoology, physical geography and physiology.

✓ In the case here chosen as an example we will omit for the time the matter of position and study the variations in points. If the second-year mark is higher than the first-year mark, then there is a gain from the first to the second year. There will also be a gain if the third-year grade is higher than the second, or the fourth-year higher than the third. On the other hand, if the second-year grade is lower than the first or the third lower than the second or the fourth lower than the third, then there is a loss.

✓ The sum of all the gains is put in the gain column; the sum of all the losses is put in the loss column. If the gains are larger than the losses, then there is a positive balance; if the losses are larger than the gains, then the difference is a negative balance. The sum of all the gains and losses, regardless of sign, is put in the total column.

In the subject of English (on the card chosen for an example) it will be noted that from first to the second year there is a gain of 3 points, and that from the third to the fourth year another gain of 1 point is made, so that there is a total gain of 4 points, which is placed in the gain column. From the second to the

third year there is a loss of 8 points, which is placed in the loss column. The loss is 4 greater than the gain, so that there is a *negative balance* of 4. The sum of 4 and 8 gives the total variation, 12.

To get the average variation for a class we make an actual count of the variations from the first to the second year, then from the second to the third year, and finally from the third to the fourth year. In one class of 26 the following results were gotten in the manner indicated above:

*Variations in Points from First to Second Year.*

Pupils.		Variations.		Totals.
3	make	0	equals	0
3		1		3
2		2		4
4		3		12
1		4		4
3		5		15
2		6		12
1		7		7
2		8		16
2		9		18
2		10		20
1		15		15
<hr/>				
26				126

To determine the average variation it is only necessary to divide the total number of variations by the number of pupils; that is, 126 divided by 26 equals 4.8, which is the average variation\* of the

---

\*The term "Average Variation" is not used here with the meaning usually given it in statistical work, but refers to the averages of the variations which a group of pupils make in their grades or rank as they pass from year to year.

class from the first to the second year. It will be noted, too, from the table that the variations are relatively small. Only ten pupils vary more than five points, and only three vary ten or more points.

*Variations in Points from the Second to the Third Year.*

Pupils.	Variations.	Totals.
4	0	0
5	1	5
3	2	6
3	4	12
4	5	20
1	6	6
1	7	7
1	8	8
3	11	33
1	13	13
<hr/> 26		<hr/> 110

110 divided by 26 equals 4.2, Av. Var.

Here, again, the great majority of these pupils have less than five points of variation.

*Variation in Points from the Third to the Fourth Year.*

Pupils.	Variations.	Totals.
5	0	0
5	1	5
6	2	12
3	3	9
2	4	8
1	5	5
2	7	14
1	8	8
1	10	10
<hr/> 26		<hr/> 71

71 divided by 26 gives 2.7, Av. Var.

To determine the average variation for the four years, we may take the average of the three variations already found. This is 3.9.

Now, the same material may be worked over to find the positional variations. / In order to give each pupil a relative position in a class of 25, the class was divided into quintiles. In making these divisions the five highest grades were put in the first division, the next highest five in the second division, and so on until the twenty-five are canvassed. /

In one class of 25 the divisions\* for the first year English work were as follows (Roman figures indicate the quintiles):

I.	II.	III.	IV.	V.
95	86	85	80	76
92	86	84	80	74
91	86	82	79	73
90	85	81	78	72
89	85	81	76	71

The position, *i. e.*, the quintile, of each pupil is marked on his card for this year in English, and the same process is gone through for the second and subsequent years, so that finally each pupil has a 'position' in each subject for each year.

When the pupil has been given a position in each subject, his card will resemble the following:

---

\*It might be noted that the lowest grade in the second quintile is 85, and that the highest grade in the third quintile is also 85. The like fact also appears in the fourth and fifth quintiles. This is simply a shortcoming of the machinery of the investigation, and while it may raise the average variation in position, yet the results will not be materially changed. In any case the variations are not likely to be lowered by these accidents in the methods of calculation.



Name or number 14Second High School.

		1st Year	2d Year	3d Year	4th Year	Gain	Loss	Pos. Bal.	Neg. Bal.	Total
English.....	Grade ....	70	70	70	72					
	Position ..	5	5	5	5					
History.....	Grade ....		70	71	75					
	Position ..		5	5	4					
Mathematics...	Grade ....	72	77	73	75					
	Position ..	5	3	4	5					
Latin .....	Grade ....									
	Position ..									
Modern Languages...	Grade ....	74	77	70						
	Position ..	4	5	5						
Science .....	Grade ....	75		72	71					
	Position ..	5		5	5					

In mathematics from the first to the second year this pupil passes from the fifth to the third quintile, so that a gain of two positions is placed in the gain column. From the second to the third year there is a loss of one position and from the third to the fourth year there is a loss of another position, making a total loss of two positions, which is placed in the loss column. Since the loss is equal the gains, there is neither a negative or positive balance. The total variation is 4.

When each school subject has been treated in this manner, the card will appear as follows:

Name or number 14Second High School.

		1st Year	2d Year	3d Year	4th Year	Gain	Loss	Pos. Bal.	Neg. Bal.	Total
English.....	Grade....	70	70	70	72					
	Position..	5	5	5	5	--	--	--	--	--
History.....	Grade....		70	71	75					
	Position..		5	5	4	1	--	1	--	1
Mathematics ..	Grade....	72	77	73	75					
	Position..	5	3	4	5	2	2	--	--	4
Latin .....	Grade....									
	Position..									
Modern Languages...	Grade....	74	77	70						
	Position..	4	5	5		--	1	--	1	1
Science .....	Grade....	75		72	71					
	Position..	5		5	5	--	--	--	--	--

The next step is to make out tables similar to those made out for the variations in points. The following table was secured for a class of 25 in English from the first to the second year :

Pupils.	Variations.	Totals.
9	0	0
13	1	13
2	2	4
1	3	3
<hr/> 25		<hr/> 20

$20 \div 25 = .80$  as the average variation in position.

In like manner other tables could be arranged for the variations from the second to the third or from the third to the fourth year.

The three tables for either the variations in points or in position can be reduced to one table by taking into consideration the results given in the total column and the number of opportunities which each pupil has for variation. The opportunities depend upon the number of years that a pupil pursues a subject. That is, if algebra is studied two years, there is only one opportunity to vary, since there can be no variation until after the pupil has received one grade. In the same way if a study is pursued for three years, there are two opportunities for variation; if for four years, three opportunities.

The following table will illustrate the above points:

Pupils.	Opportunities for each.	Total opportunities.	Variations.	Totals.
2	3	6	2	4
1	3	3	4	4
2	3	6	5	10
3	3	9	6	18
3	3	9	7	21
2	3	6	9	18
1	3	3	10	10
1	3	3	11	11
1	3	3	12	12
1	3	3	14	14
1	3	3	15	15
1	3	3	16	16
1	3	3	19	19
1	3	3	20	20
1	3	3	21	21
1	3	3	23	23
1	3	3	29	29
1	3	3	43	43
<hr/> 25		<hr/> 75		<hr/> 308

308 (the total number of variations) divided by 75 (the number of opportunities) gives 4.0 average variation.

In most cases the number of opportunities is not so easily calculated, because not all the pupils pursue the same subject for the same length of time. Thus, many take history for two years, while others continue it for three or four years. This makes it necessary to count the opportunities for each pupil. For this reason the number of opportunities has been indicated at the end of each table.

## RESULTS.

### *A. Variations in Different Subjects in the Several Schools.*

The following tables show the results for the different schools in the different subjects:

TABLE 1.

*Table for Total Variations in Points for English.—School 1.*

Pupils.	Variations.	Totals.
1	1	1
6	3	18
3	4	12
10	5	50
5	6	30
10	7	70
13	8	104
8	9	72
8	10	80
12	11	132
9	12	108
6	13	78
5	14	70
4	15	60
7	16	112
5	17	85
2	18	36
3	19	57
2	20	40
5	22	110
2	23	46
2	24	48
128		1419

Total Opportunities, 374.  
 $1419 \div 374 = 3.7$ , Av. Var.

TABLE 2.

*Table for Gains in Points in English.—School 1.*

Pupils.	Variations.	Totals.
29	0	0
16	1	16
21	2	42
15	3	45
10	4	40
10	5	50
7	6	42
6	7	42
7	8	56
1	9	9
3	10	30
2	11	22
1	13	13
<hr/> 128		<hr/> 407

Total Opportunities, 374.  
 $407 \div 374 = 1.06$ , Av. Gain.

TABLE 3.

*Table for Losses in Points in English.—School 1.*

Pupils.	Variations.	Totals.
3	0	0
3	1	3
10	3	30
10	4	40
10	5	50
10	6	60
14	7	98
12	8	96
16	9	144
8	10	80
10	11	110
5	12	60
4	13	52
8	14	112
3	15	45
2	16	32
<hr/> 128		<hr/> 1012

Total Opportunities, 374.  
 $1012 \div 374 = 2.66$ , Av. Loss.

A comparison of Tables 2 and 3 shows that there is a strong tendency in this school to mark more severely in English during the later years than during the earlier ones, since losses predominate over gains.

TABLE 4.

*Table for Total Variations in Points in History.—School 3.*

Pupils.	Variations.	Totals.
17	0	0
2	1	2
7	2	14
12	4	48
21	5	105
2	6	12
14	8	112
3	9	27
4	10	40
4	12	48
3	13	39
3	14	42
2	15	30
2	16	32
3	17	51
4	18	72
1	19	19
1	20	20
1	21	21
2	22	44
1	27	27
1	28	28
1	35	35
<hr/> 111		<hr/> 868

Opportunities to vary, 259,  
 $868 \div 259 = 3.3$ , Av. Var.

TABLE 5.

*Table for Total Variations in Points in Mathematics.—School 4.*

Pupils.	Variations.	Totals.
2	4	8
1	5	5
1	6	6
1	8	8
1	9	9
1	10	10
2	11	22
1	12	12
2	13	26
2	15	30
2	17	34
1	18	18
1	19	19
3	21	63
1	22	22
1	24	24
1	28	28
1	37	37
<hr/> 25		<hr/> 381

Opportunities to vary, 75.  
 $381 \div 75 = 5.0$ , Av. Var.

TABLE 6.

*Table for Total Variations in Points in Latin.—School 5.*

Pupils.	Variations.	Totals.
1	1	1
2	7	14
2	8	16
2	9	18
1	13	13
3	15	45
2	16	32
2	18	36
1	19	19
2	20	40
1	21	21
3	22	66
1	24	24
<hr/> 23		<hr/> 345

Opportunities to vary, 68.  
 $345 \div 68 = 5.0$ , Av. Var.



TABLE 7.

*Table for Total Variations in Modern Languages in Points.—  
School 7.*

Pupils.	Variations.	Totals.
2	0	0
5	1	5
2	2	4
2	3	6
3	4	12
2	5	10
1	6	6
3	8	24
1	9	9
1	10	10
1	11	11
4	12	48
1	14	14
1	16	16
1	19	19
<hr/> 30		<hr/> 194

Opportunities to vary, 55.  
 $194 \div 55 = 3.5$ , Av. Var.

TABLE 8.

*Table for Total Variations in Points in Science.—School 1.*

Pupils.	Variations.	Totals.
2	0	0
6	1	6
2	2	4
4	3	12
6	4	24
12	5	60
5	6	30
8	7	56
7	8	56
7	9	63
16	10	160
8	11	88
9	12	108
7	13	91
2	14	28
2	15	30
2	16	32
4	17	68
2	18	36
4	19	76
2	20	40
1	21	21
1	22	22
4	23	92
1	30	30
1	33	33
<hr/> 125		<hr/> 1269

Opportunities to vary, 251.  
 $1269 \div 251 = 5.0$ , Av. Var.

## VARIATIONS IN GRADES

TABLE 9.

*Table for Total Variations in Position in English.—School 1.*

Pupils.	Variations.	Totals.
19	0	0
25	1	25
23	2	46
21	3	63
16	4	64
9	5	45
3	6	18
2	7	14
<hr/> 128		<hr/> 275

Total Opportunities, 374.  
 $275 \div 374 = 0.74$ , Av. Var.

TABLE 10.

*Table for Gains in Position in English.—School 1.*

Pupils.	Variations.	Totals.
46	0	0
42	1	42
24	2	48
11	3	33
2	4	8
3	5	15
<hr/> 128		<hr/> 146

Total Opportunities, 374.  
 $146 \div 374 = 0.39$ , Av. Gain.

TABLE 11.

*Table for Losses in Position in English.—School 1.*

Pupils.	Variations.	Totals.
38	0	0
45	1	45
27	2	54
12	3	36
6	4	24
<hr/> 128		<hr/> 159

Total Opportunities, 374.  
 $159 \div 374 = 0.43$ , Av. Loss.

TABLE 12.

*Table for Variations in Position in Mathematics.—School 3.*

Pupils.	Variations.	Totals.
33	0	0
26	1	26
42	2	84
25	3	75
10	4	40
7	5	35
2	6	12
<hr/> 145		<hr/> 272

Total Opportunities, 278.  
 $272 \div 278 = 0.97$ , Av. Var.

TABLE 13.

*Table for Variations in Position in History.—School 2, Second Year.*

Pupils.	Variations.	Totals.
5	0	0
8	1	8
5	2	10
3	3	9
3	4	12
1	5	5
<hr/> 25		<hr/> 44

Total Opportunities, 75.  
 $44 \div 75 = 0.58$ , Av. Var.

## VARIATIONS IN GRADES

TABLE 14.

*Table for Total Variations in Position in Latin.—School 1.*

Pupils.	Variations.	Totals.
26	0	0
26	1	26
25	2	50
10	3	30
4	4	16
1	5	5
<hr/>		<hr/>
92		127

Total Opportunities, 107.  
 $127 \div 107 = 1.2$ , Av. Var.

TABLE 15.

*Table for Total Variations in Position in Modern Languages.—School 3.*

Pupils.	Variations.	Totals.
15	0	0
19	1	19
13	2	26
10	3	30
2	4	8
1	6	6
<hr/>		<hr/>
60		89

Total Opportunities, 109.  
 $89 \div 109 = 0.81$ , Av. Var.

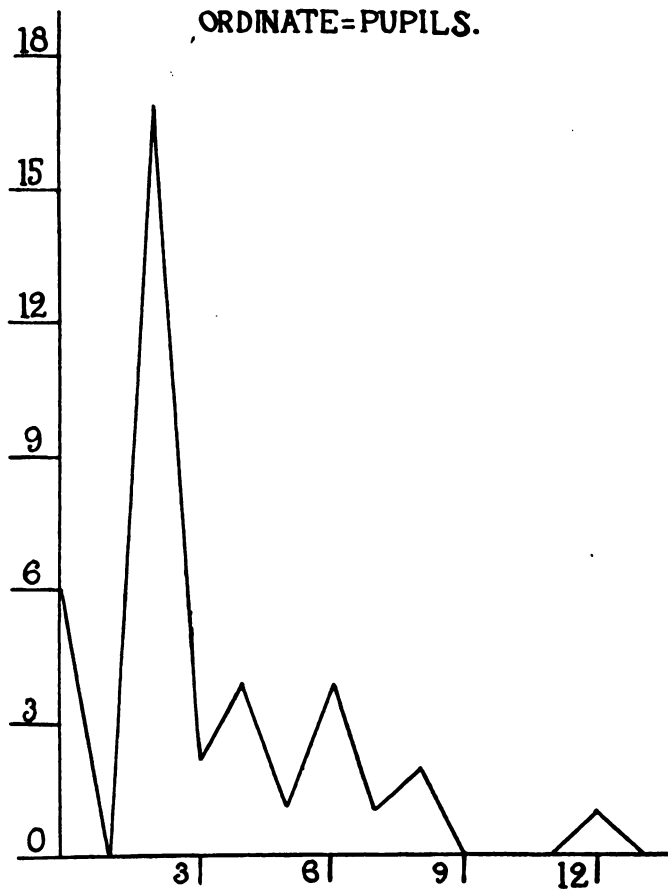
TABLE 16.

*Table for Variations in Position in Science.—School 3.*

Pupils.	Variations.	Totals.
23	0	0
38	1	38
28	2	56
22	3	66
10	4	40
2	5	10
3	6	18
<hr/>		<hr/>
126		228

Total Opportunities, 309.  
 $228 \div 309 = 0.80$ , Av. Var.

**PLATE 7.**  
**CURVE BASED ON THE TOTAL VARIATIONS IN**  
**PERCENT IN MATHEMATICS FOR SCHOOL 9.**  
**ABSCISSA=VARIATIONS.**  
**ORDINATE=PUPILS.**



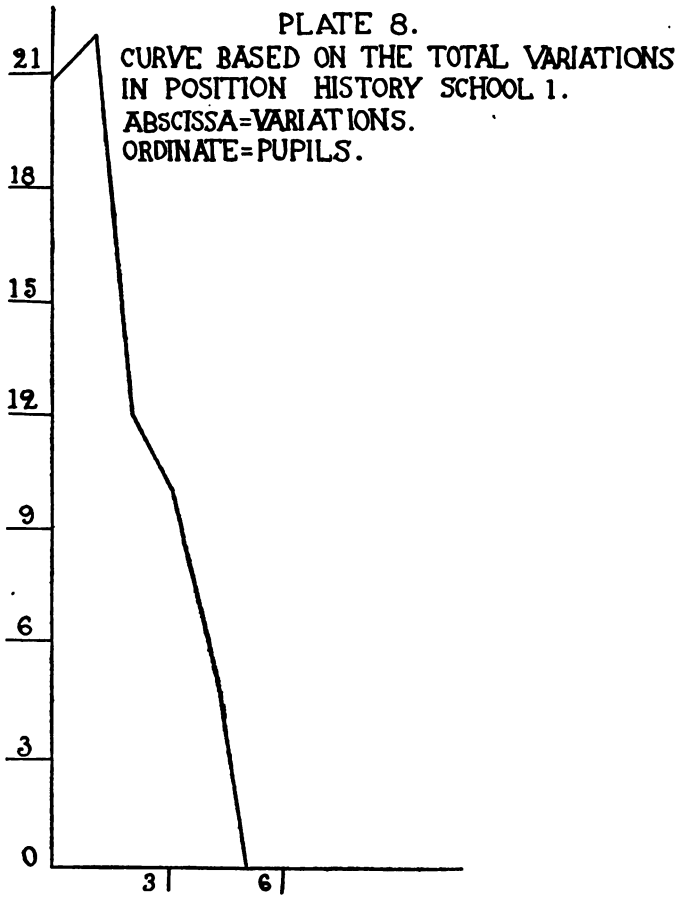


TABLE 17.

*Table Comparing Averages for Variations in Points.  
Subject, English.*

	Totals.	Gains.	Losses.
School 1.....	3.7	1.0	2.6
School 2—1 yr.....	4.1	1.9	2.2
2 yr.....	3.3	1.6	1.8
3 yr.....	3.0	2.0	1.0
4 yr.....	4.4	3.1	1.7
Average.....	3.7	2.1	1.7
School 3.....	4.1	2.6	1.5
School 4.....	3.6	1.8	1.8
School 5.....	5.6	2.4	3.2
School 6.....	3.5	1.4	2.1
School 7.....	4.0	2.8	1.2
School 8.....	3.8	1.4	2.4
School 9.....	4.2	2.8	1.4
School 10.....	3.9	..	..
Average.....	4.0	2.0	1.9

TABLE 18.

*Comparing Variations in Points in History.*

	Totals.	Gains.	Losses.
School 1.....	4.4	2.2	2.2
School 2—1 yr.....	3.8	2.0	1.8
2 yr.....	3.0	1.5	1.5
3 yr.....	2.7	1.0	1.7
4 yr.....	3.5	1.4	2.1
Average.....	3.3	1.5	1.8
School 3.....	3.3	2.1	1.2
School 4.....	3.8	1.9	1.9
School 5.....	4.1	1.8	2.3
School 6.....	3.5	1.7	1.8
School 7.....	5.3	2.9	2.4
School 8.....	3.6	0.7	2.8
School 9.....	2.8	1.5	1.3
Average.....	3.8	1.8	1.9



## VARIATIONS IN GRADES

TABLE 19.

*Comparing Variations in Points in Mathematics.*

	Totals.	Gains.	Losses.
School 1.....	4.7	1.6	3.1
School 2—1 yr.....	6.2	2.8	3.5
2 yr.....	4.6	2.3	2.5
3 yr.....	5.2	2.5	3.0
4 yr.....	3.0	2.0	1.0
Average.....	4.7	2.4	2.3
School 3.....	4.6	1.6	3.0
School 4.....	5.0	2.8	2.2
School 5.....	5.9	2.8	3.1
School 6.....	4.1	1.7	2.4
School 7.....	3.7	2.0	1.7
School 8.....	4.4	1.2	3.2
School 9.....	1.5	0.5	0.9
School 10.....	4.5	..	..
Average.....	4.3	1.8	2.4

TABLE 20.

*Comparing Variations in Points in Latin.*

	Totals.	Gains.	Losses.
School 1.....	3.5	1.0	2.5
School 2—1 yr.....	3.2	1.4	1.8
2 yr.....	3.9	2.3	1.6
3 yr.....	2.2	1.6	0.6
4 yr.....	2.1	1.1	1.0
Average.....	2.8	1.6	1.2
School 3.....	3.6	1.7	1.9
School 4.....	4.4	1.9	2.5
School 5.....	5.0	1.6	3.4
School 6.....	2.5	1.5	1.0
School 7.....	3.2	1.1	2.1
School 8.....	3.2	1.1	2.1
School 9.....	3.6	1.2	2.4
Average.....	3.5	1.4	2.1

TABLE 21.

*Comparing Variations in Points in Modern Languages.*

	Totals.	Gains.	Losses.
School 1.....	4.0	0.9	3.1
School 2.....	*	*	*
School 3.....	3.4	2.0	1.4
School 4.....	3.1	2.2	0.9
School 5.....	*	*	*
School 6.....	2.3	1.6	0.7
School 7.....	*	*	*
School 8.....	3.5	1.2	2.3
School 9.....	3.2	1.9	1.3
	—	—	—
Average.....	3.2	1.6	1.6
*Data insufficient.			

TABLE 22.

*Comparing Variations in Points in Science.*

	Totals.	Gains.	Losses.
School 1.....	5.0	1.6	3.4
School 2.....	*	*	*
School 3.....	3.6	1.5	2.1
School 4.....	3.0	1.0	2.0
School 5.....	5.4	2.1	3.3
School 6.....	6.3	2.4	3.9
School 7.....	*	*	*
School 8.....	5.0	2.3	2.7
School 9.....	4.6	2.6	2.0
School 10.....	4.9	..	..
	—	—	—
Average.....	3.7	1.5	2.1
*Data insufficient.			

The variations of School 10 in drawing is 3.9, and in shop work 4.6.

TABLE 23.

*Comparing Variations in Position.*

	English.	History.	Mathe- matics.	Latin.	Mod. Lang.	Science.
School 1.....	1.00	0.76	1.00	1.20	0.84	1.10
School 2.....	0.66	0.93	0.88	0.50	...	...
School 3.....	0.86	0.56	0.97	0.74	0.81	0.80
School 4.....	0.69	0.88	0.76	0.82	0.67	0.54
School 5.....	1.30	1.10	1.20	1.00	...	1.30
School 6.....	0.76	0.76	0.80	0.44	0.46	0.88
School 7.....	0.78	0.83	0.40	0.69	...	...
School 8.....	1.00	0.64	1.00	0.80	0.85	1.10
School 9.....	0.80	0.78	0.43	0.77	0.64	1.30
Average...	0.87	0.80	0.82	0.77	0.74	1.00

✓ In the averages, the greatest variation is in Science, with English next. The large variation in Science can possibly be explained by the fact that the material used in the different years is unrelated; that is, the work in Physiography of the first year would be of little help to the work in Physics in the third year. The large variation in English seems to be due in a ✓ large degree to the erratic grading of this department in many of the schools.

School 5 exhibits the greatest variability. The probable explanation is to be found in a severe struggle which this school has had with fraternities. It is not at all strange that such a struggle should affect the grades of the school.

School 10 is a well-established Manual Training School in Chicago. This school was put in the list because it was suggested that the interest of the pupils in their work in such a school would reduce the variations to a marked degree. This proves not to be true, for the variations made are approximately those made by other schools. If the interest of the

pupils is greater (which may, with good reasons, be doubted), these data only indicate that the variation of a pupil's work is due to a large extent to influences over which the pupil has no control.

*B. Variations of Pupils of Different Quintiles.*

The question may now be raised: Which of the five groups of pupils shows the greatest variation? To answer this question those who are in the first quintile the first year are taken as the first quintile; those who are in the second quintile for the first year are considered as the second quintile, and so on to the fifth quintile. The total number of variations in position for each quintile is then determined. Some typical results follow:

TABLE 24.  
*Variations of Pupils of Different Quintiles.*

	School 4.		School 6.	
	Quintile.	Variation.	Quintile.	Variation.
English.....	1	5	1	8
	2	11	2	16
	3	17	3	13
	4	10	4	14
	5	8	5	13
History.....	1	6	1	8
	2	6	2	12
	3	14	3	9
	4	9	4	8
	5	9	5	6
Mathematics....	1	7	1	11
	2	15	2	20
	3	11	3	17
	4	12	4	13
	5	13	5	6
Science.....	1	5	1	7
	2	6	2	14
	3	9	3	9
	4	15	4	8
	5	5	5	9

It will be noted that in not a few cases the first and fifth quintiles make the fewest variations, while the third makes the most. The fact that the first and fifth make the fewest variations may be due to the fact that these quintiles have only half as many chances to vary as the other quintiles; that is, the first quintile cannot go into a higher quintile and those in the fifth cannot go lower if they are to remain in the class. On the other hand, it may be argued that the first quintile stands for greater ability, energy, etc., and so is a more constant quantity. It might also be said of the fifth quintile that it is composed of pupils of less ability, and, since the only change which this group can make is an advance, the chances are that those in it will not change position. The reason the third quintile is the one to exhibit the largest variation seems to be that this group comes at a place in the grading scale where it is easier to change position than at any other place. By this is meant that it is much easier to shift from 85 to 88 than from 95 to 98, and that it is not so serious to shift from 85 to 80 as from 75 to 70, so that the tendency will be for teachers to vary the marks of this group more than those of the other groups.

## EXPLANATION OF THE VARIATIONS.

### *A. Explanation of Some Individual Variations.*

The pupils in School 2 were all well known to the author, so that explanations can be offered for some individual cases. In the following tables those pupils that show an average variability greater than 5 are indicated by figures at the left. In a few cases it is possible to give an explanation for pupils whose average variation is less than 5. These pupils are indicated by letters at the left.

TABLE 25.

*Variations in English.—First Year, in Points, by Quarters.*

Pupils.	Variations.	Totals.
2	2	4
1	4	4
2	5	10
3	6	18
3	7	21
2	9	18
1	10	10
1	11	11
1	12	12
(a) 1	14	14
(b) 1	15	15
(1) 1	16	16
(2) 1	19	19
(3) 1	20	20
(4) 1	21	21
(5) 1	23	23
(6) 1	29	29
(7) 1	43	43

No. 7 was a country student who had had little or no training in English. He could do some of the work well, but some of it scarcely at all, so that as the work changed from quarter to quarter his grades went up and down. His health was also a hindrance.

No. 6 was a boy who did poor work at the beginning of the year, but who, by the end of the first half-year, was doing work of 90 per cent. grade. By the close of the year he had lost all interest, and did not return the next year.

No. 5 was a boy who had the idea that the high school was a place for fun. After a severe punishment for some misconduct he settled down and did good work for a while, but was soon back at his old tricks.

No. 4 was a very bright girl, but her teachers always complained that she would not do consistent work.

No. 3 was a girl who attempted to copy her way through school. She copied her written work from day to day, and used every means to copy on tests and examinations. When the teachers applied means to stop this, her grades naturally fell off decidedly. She never graduated.

No. 2 was a boy who was very much interested in the outside affairs of the school. Later in his course he made several failures.

No. 1 was a student from the country. While a consistent student, it seemed to take her the first quarter to get settled in her new surroundings. Most of her variation was made from the first to the second quarter.

Very little explanation can be given for (a) and

(b). Lack of interest near the end of the year may account for a part of it. For the other students in Table 25 no explanation can be given.

TABLE 26.

*Table for Variations in History.—First Year, School 2.*

Pupils.	Variations.	Totals.
1	2	2
3	3	9
1	4	4
1	5	5
1	6	6
1	7	7
2	8	16
1	9	9
1	10	10
1	12	12
(1) 1	16	16
(2) 2	17	34
(3) 1	20	20
(4) 1	21	21
(5) 1	28	28
(6) 1	33	33

No. 6 is the same pupil as No. 2 in English (Table 25).

No. 5 was a country student who did poor work for the first two quarters, and then did 90 per cent. work for the remainder of the time.

No. 4 is No. 7 in English.

No. 3 is No. 6 in English.

One of the two numbered 2 was a student who started in this subject at 78 per cent., but by the end of the year was doing work worth 95 per cent.

The second one numbered 2 is Pupil 1 in English.

No. 1 was a boy who had to do much outside work in order to be able to stay in school.

For the remaining pupils no explanation can be offered. It is to be noted that several pupils who



show large variations here are those who show large variations in English.

In this manner each subject for each year was canvassed. The following table (No. 27) will indicate that pupils who exhibit marked variation in one subject will, in many cases, exhibit marked variation in one or more other subjects.

The X indicates the subject where the pupil's variation first appears. The R indicates that the variation is also shown in the subject opposite.

TABLE 27.

*First Year Pupils.—School 2.*

Pupils.	1	2	3	4	5	6	7	8	9	10	11	12	13
English.....	X	X	X	X	X	X	X	—	—	—	—	—	—
History.....	R	R	—	—	—	R	R	X	X	—	—	—	—
Mathematics.	R	R	R	R	—	R	R	—	—	—	X	X	X
Latin.....	—	R	R	—	—	—	—	—	R	R	—	—	—

TABLE 28.

*Per Cent. of Pupils Whose Average Variation Is Greater or Less than Five Points.*

School.	Variation.	Eng-lish.	His-tory.	Math.	Latin.	Mod.Lang.	Science.
No. 3.—	Five or less than 5...	61	74	67	68	75	73
	Greater than 5.....	39	26	33	32	25	27
No. 4.—	Five or less than 5...	72	72	56	76	81	80
	Greater than 5.....	28	28	44	24	19	20
No. 5.—	Five or less than 5...	48	74	52	48	..	65
	Greater than 5.....	52	26	48	52	..	35
No. 6.—	Five or less than 5...	75	63	68	84	90	64
	Greater than 5.....	25	37	32	16	10	36
No. 7.—	Five or less than 5...	70	46	76	70	..	..
	Greater than 5.....	30	54	24	30	..	..
No. 8.—	Five or less than 5...	76	72	63	74	70	50
	Greater than 5.....	24	28	37	26	30	50
No. 9.—	Five or less than 5...	66	90	97	71	95	74
	Greater than 5.....	34	10	3	29	5	26

In the same manner, 1 was taken as a basis for total variations in position, and the per cent. of those who showed a greater or less variation was calculated in the same way. Table 29 embodies results for some of the schools.

TABLE 29.

*Per Cent. of Pupils Whose Average Variation Is Greater or Less than One Position.*

School.	Variation.	Eng-lish.	His-tory.	Math.	Latin.	Mod. Lang.	Science.
No. 3.—	One or none.....	72	87	66	80	73	75
	Greater than 1.....	28	13	34	20	27	25
No. 4.—	One or none.....	84	80	88	100	87	96
	Greater than 1.....	16	20	12	..	13	4
No. 5.—	One or none.....	74	61	56	74	..	61
	Greater than 1.....	26	39	44	26	..	39
No. 6.—	One or none.....	79	85	72	89	90	93
	Greater than 1.....	21	15	28	11	10	7
No. 7.—	One or none.....	81	72	100	92	..	..
	Greater than 1.....	19	28	..	8	..	..

From this examination of individual cases and tables 28 and 29 we may conclude:

(1) There is a class of students in our high schools whose work is characterized by great variability. (2) Many of those students who show high variations in one subject also show high variations in other subjects. (3) It is possible in some cases to explain a greater variation than five by means of certain elements in the pupil's school life over which the pupil has more or less control, but a less variation than five evidently has some other explanation. (4) Certain causes of variation, such as lack of interest and difficulty of adjustment to new conditions, offer serious problems in high-school administration.

*B. Some Alleged General Causes of Variations.*

While the author was collecting this material many persons suggested to him that home conditions, application, deportment and social tendencies were factors which entered into the problem to a very great degree. †

In order to see what effect these had upon the variations made by pupils, he took his own school, which was in a town of about 3000 inhabitants. Since he had been there a number of years and was perfectly familiar with all the conditions, he was able to assign to each pupil a grade in each of the points mentioned above.

If the home was one where the parents were interested in the school and who asked about the progress of the pupil occasionally, or if they were persons to whom the teacher might go for a consultation with perfect assurance that he would be well received, that home was graded A. Other homes were graded B, C or D.

In case of the social tendencies, the pupil's personality, social standing and the social standing of the family were taken into consideration. The same grades, A, B, C and D, were given here and for other points mentioned. In order to check this part of the work, another teacher who was familiar with these conditions was asked to grade some of the pupils. These grades were found in nearly every case to agree with those given by the author.

After the grading was done the total variations, gains and losses were counted for each grade in all the points under consideration. The only subject used was English.

The results for home conditions, deportment, application and social tendencies are shown in Tables 30-33.

TABLE 30.

*Relation of Home Conditions to Total Variations (1126),  
Gains (654) and Losses (473) in English.*

Graded.	(Homes.)	Total Variations.		(Gains.)		(Losses.)	
	Per cent.	Abso- lute.	Per cent.	Abso- lute.	Per cent.	Abso- lute.	Per cent.
A	51	547	48	294	44	254	53
B	32	425	37	268	40	155	33
C	9	96	8	43	6	47	10
D	8	60	5	49	7	17	4

TABLE 31.

*Relation of Deportment to Total Variations,  
Gains and Losses in English.*

Graded.	Deportment.	Total Variations.		(Gains.)		(Losses.)	
	Per cent.	Abso- lute.	Per cent.	Abso- lute.	Per cent.	Abso- lute.	Per cent.
A	70	731	65	444	67	279	59
B	18	259	23	144	22	115	24
C	10	106	9.3	62	10	53	11
D	2	30	2.5	4	.006	26	5

TABLE 32.

*Relation of Application to Total Variations,  
Gains and Losses in English.*

Graded.	Application.	Total Variations.		(Gains.)		(Losses.)	
	Per cent.	Abso- lute.	Per cent.	Abso- lute.	Per cent.	Abso- lute.	Per cent.
A	31	303	27	168	26	125	26
B	37	396	35	257	39	154	32
C	27	350	31	199	30	151	32
D	5	77	7	30	5	43	10

TABLE 33.

*Relation of Social Tendencies to Total Variations,  
Gains and Losses in English.*

Social Tend. Graded.	Total Variations.		Gains.		Losses.	
	Per cent.	Abso- lute.	Per cent.	Abso- lute.	Per cent.	Abso- lute.
A	27	263	23	141	22	116
B	15	203	18	120	18	83
C	23	192	17	131	20	59
D	35	468	41	262	40	211

A study of these tables cannot fail to impress one with the fact that there is little or no correlation between the variations and the home conditions, deportment, application or social tendencies. The conclusion to be reached here is that the very things which are usually supposed most to affect the variability of a pupil's marks have really very little to do with them.

### *C. Distribution of Grades As a Factor in Variation.*

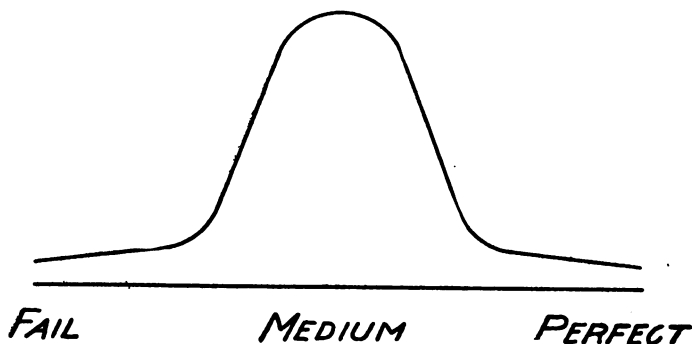
We next enter upon a discussion of the ways in which it is possible to distribute a set of grades. This general discussion will lead to a consideration of the types of variation found in the schools above reported, and we shall then be able to see just what happened when the different variations mentioned on the preceding pages were made.

A teacher gives grades to the individuals of a class in order to communicate to them her estimates of their ability. Of course, the term ability means something very different in English from what it does in mathematics, but in either case the grade is a symbol of the teacher's estimate of the pupil. In most of the schools which are included in this re-

port 100 points was used as the symbol of perfection, and each pupil was graded with respect to this ideal. It will be noticed, too, that as soon as a pupil is located in this way he is also located in relation to his classmates; that is, he receives a position in his class. A grade of 85 points for a pupil means that his work could have been 15 points better, and also, if others make more than 85, that some one is better than he, and that he is better than those who make less than 85. One phase of grading is usually determined by the administration, namely, the range and meaning of the marks used. For instance, a superintendent directs his teachers to use 60 or 70 for a minimal passing mark—to range successful pupils between this and 100. In other cases the symbols A, B, C, D and E are used. Either system leaves the teacher to determine what particular grades she will use for individual cases, and, above all, it leaves her to decide how many of each denomination she will give.

For the moment we may confine ourselves to the matter of distribution within a system and ask how a teacher, or a department, or a school should distribute grades between the two limits 70 and 100. If grades measure ability, what do we know about ability? What grades of ability have we a right to expect to find in a school between the limits mentioned above? Psychologists have recently added much to our knowledge of the distribution of mental traits. They have shown that the probable distribution of ability is that of a chance event. The curve

for such an event would approach the following, which is known in mathematics as the curve of error:



The question now comes: Should the distribution of grades which are estimates of ability follow this distribution? Theoretically, it should. This theory is partially supported by the distribution of 8969 grades taken from Harvard College. These grades were divided into quintiles, and the per cent. falling in each division is, respectively, 7, 20, 42, 21 and 7. It is not argued that a school should follow this ideal curve exactly, but that the curve serves as a guide to keep in mind.

On the following pages Plates 9 to 19 represent the total distribution of all grades in the different schools.

PLATE 9.  
DISTRIBUTION OF ALL GRADES FOR SCHOOL 1.

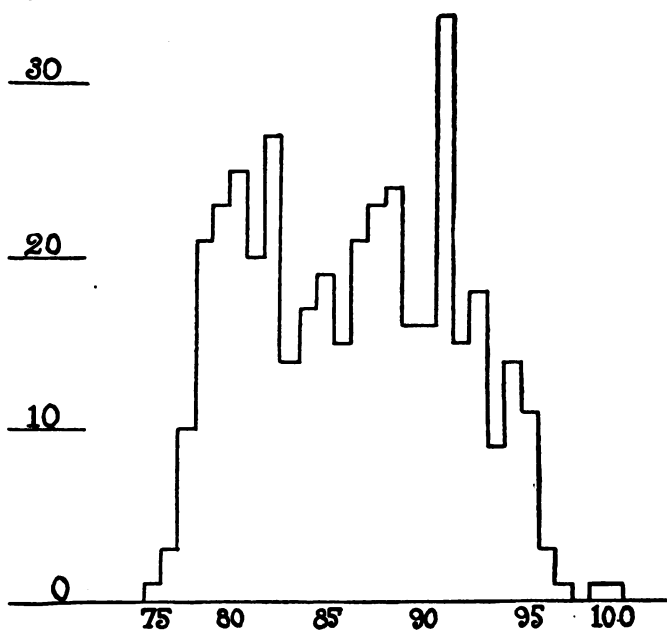




PLATE 10.  
DISTRIBUTION OF ALL GRADES FOR FIRST YEAR.  
SCHOOL 2.

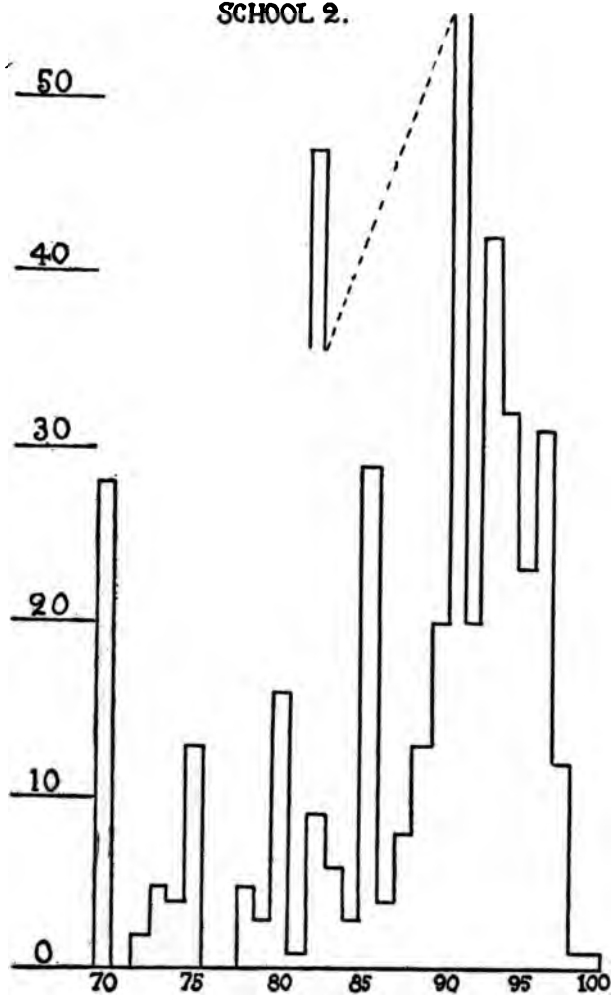
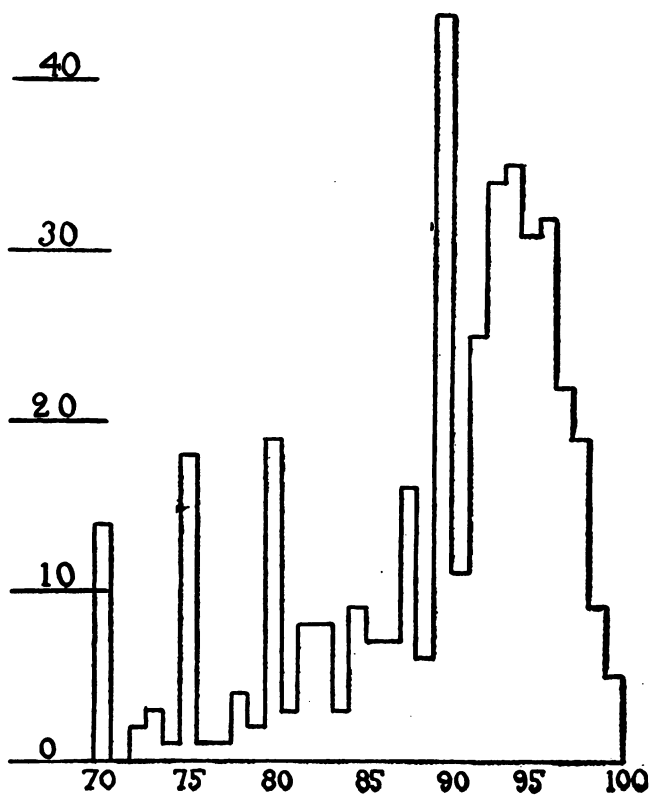
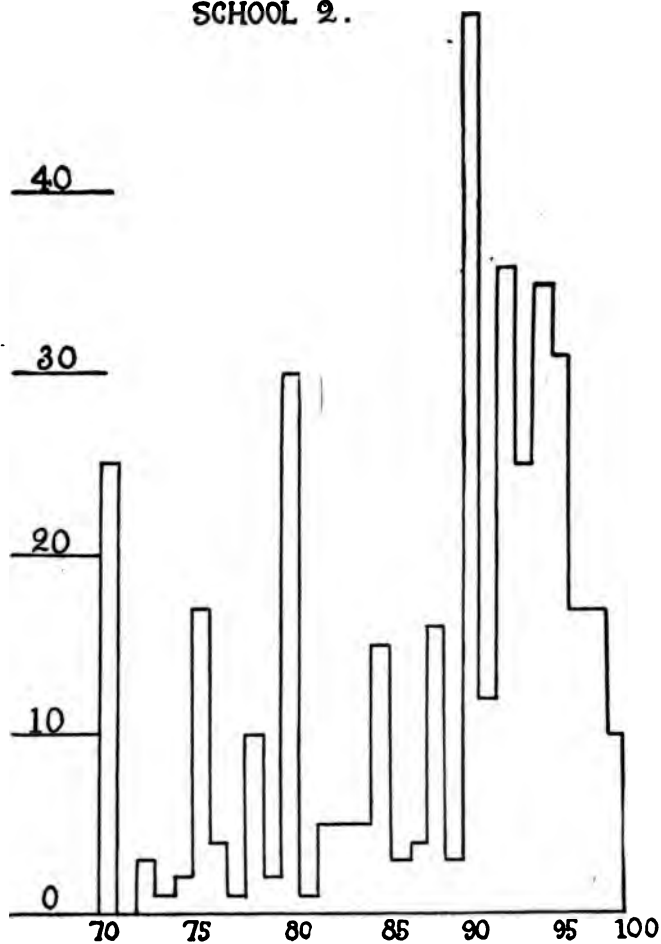


PLATE 11.  
DISTRIBUTION OF GRADES FOR SECOND YEAR.  
SCHOOL 2.



**PLATE 12.**  
**DISTRIBUTION OF ALL GRADES FOR THIRD YEAR.**  
**SCHOOL 2.**



**PLATE 13.**  
**DISTRIBUTION OF ALL GRADES FOR**  
**FOURTH YEAR. SCHOOL 2.**

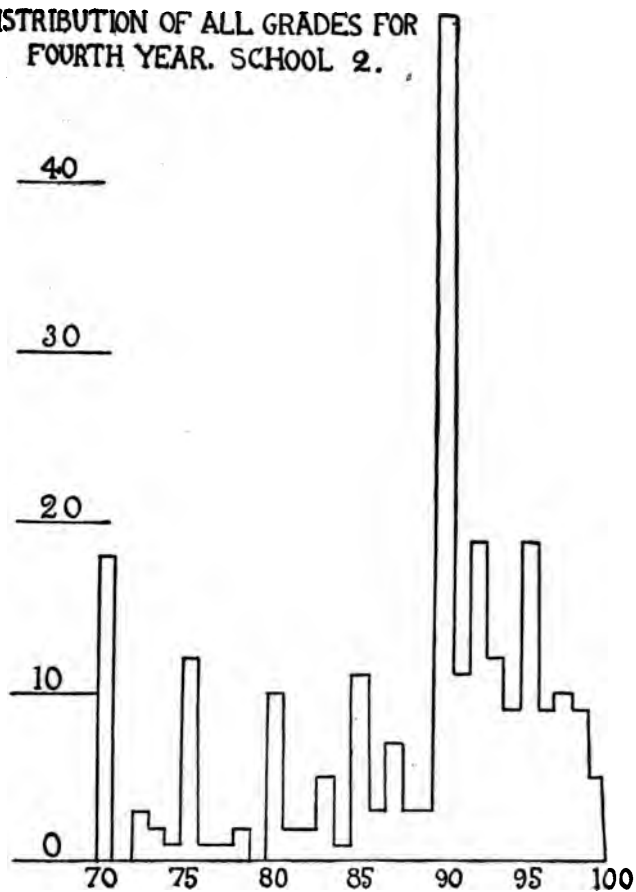


PLATE 14.  
DISTRIBUTION OF ALL GRADES FOR SCHOOL 4.

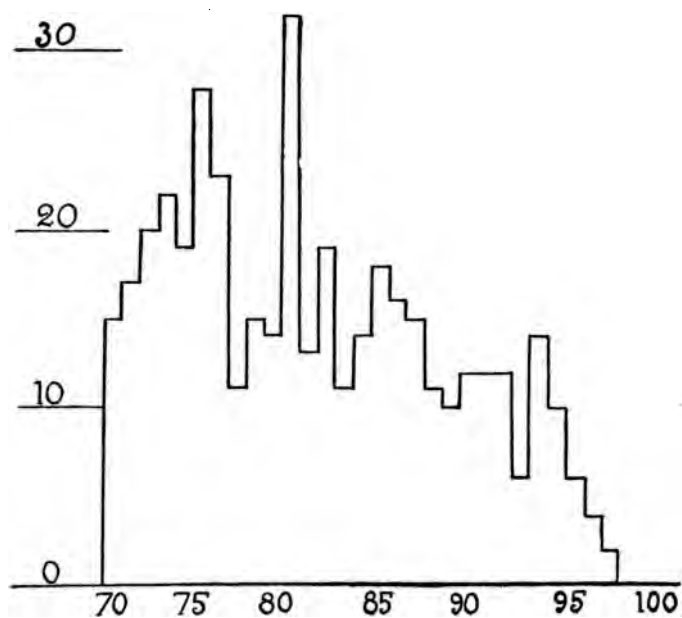
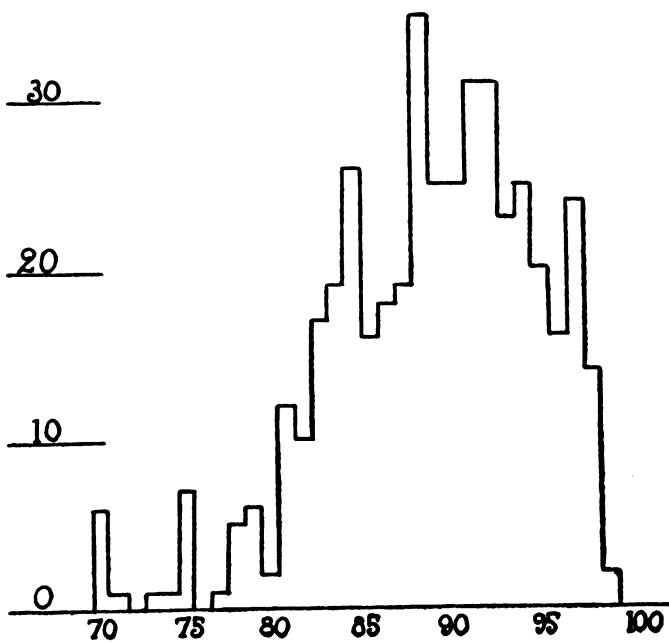
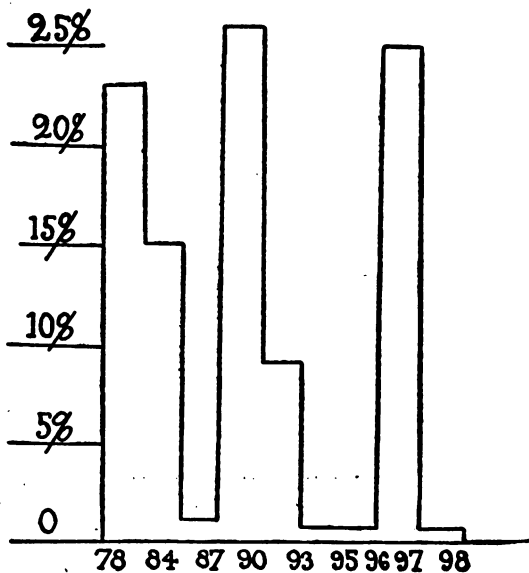


PLATE 15.  
DISTRIBUTION OF ALL GRADES FOR SCHOOL 5.



**PLATE 16.**  
**DISTRIBUTION OF ALL GRADES FOR SCHOOL 6.**  
**GRADES TRANSFERRED FROM LETTERS TO**  
**PERCENTS. SEE PAGE 7.**  
**SCALE EXPRESSED IN PERCENT.**



**PLATE 17.**  
**DISTRIBUTION OF ALL GRADES FOR SCHOOL 7.**

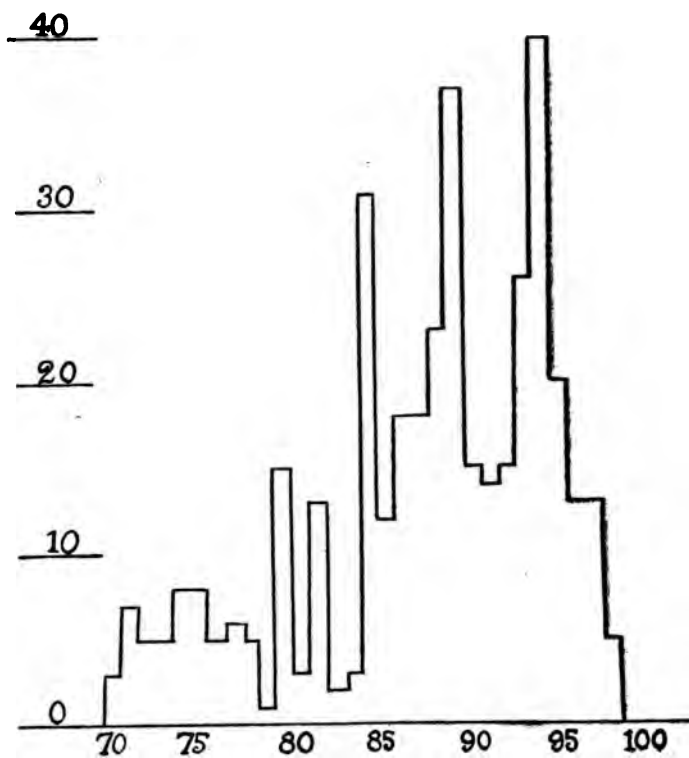




PLATE 18.  
DISTRIBUTION OF ALL GRADES FOR SCHOOL 8.

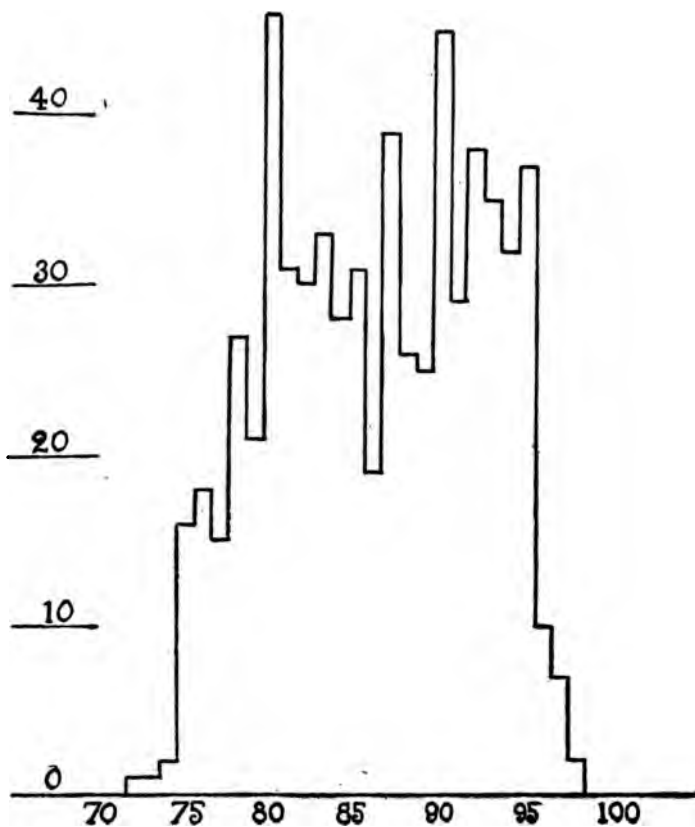
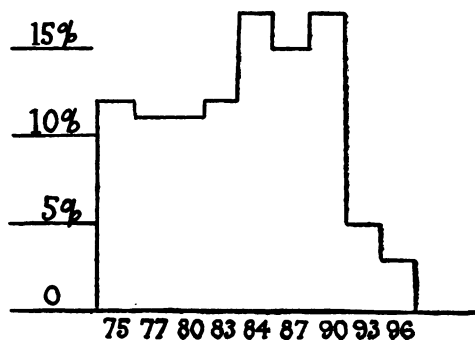


PLATE 19  
 DISTRIBUTION OF ALL GRADES FOR SCHOOL 9.  
 GRADES TRANSFERRED FROM LETTERS TO PERCENTS  
 SEE PAGE 7  
 SCALE EXPRESSED IN PERCENT.



An examination of these charts shows decided differences in distribution. These differences might be indicated in this manner:

School 1.....	Fairly normal.
School 2—1 yr.....	Very erratic.
2 yr.....	Very erratic.
3 yr.....	Very erratic.
4 yr.....	Very erratic.
School 4.....	Skewed to the right.
School 5.....	Skewed to left.
School 6.....	Trinodal. Three grades used principally.
School 7.....	Skewed to left.
School 8.....	Fairly normal.
School 9.....	Skewed to the left.

Schools 1 and 8 have a distribution which is about as near the normal curve as is usually found in actual practice. It will be noted that certain grades are carried above the main body of the curve, while on the other hand all the grades between the limits have been used, showing that an attempt has been made carefully to distinguish the different grades of ability.

It is next to impossible to justify such a distribution as that shown in the different years for School 2. An administrative feature in connection with this school is interesting. The grade 90 is an exemption-grade from the bi-monthly examinations. A casual glance shows that this grade is by far the most popular one with the teachers. They intended to be rigorous in their grading, but it seems that this feature of the marking system has caused them to be too liberal in their grading and to skew the curves decidedly to the right. It is noticeable that the multiples of five are the favored grades, while certain other

grades are not used at all. The 70-column is also worthy of note. In this school it is necessary for a pupil to do a year's work entirely over if he fails in one subject; on account of this it has become in the community generally customary for a pupil to leave school when he fails. To counteract this custom, the teachers very often condition pupils by giving them 70 instead of a mark below 70.

Schools 3 and 6 represent typical distributions for a grading system where letters are used. It will be noticed that many of the columns are fairly equal in height, which is the result to be expected since there are so few groups. The principal objection to this kind of grading is that it allows no fine discrimination, but rather groups the pupils into four or five general classes.

School 4 has a curve which is decidedly skewed to the right, *i. e.*, the school is liberal in its grading. The grades from 70 to 80 are rarely used. Only a few unfortunate ones are placed here. It would be interesting to know how pupils from a school like this would fare later at a college.

In Schools 5 and 9 we have a curve which is skewed to the left. It is to be supposed that this is an attempt to be rigorous in grading, though this may or may not be the case.

The following curves (Plates 20-25) show the distribution of the grades in English in different schools.

PLATE 20.  
DISTRIBUTION OF ENGLISH GRADES FOR SCHOOL 1.

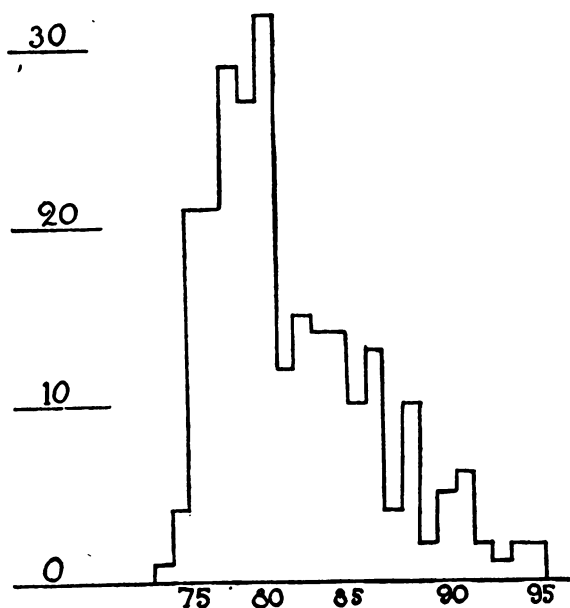


PLATE 21.  
DISTRIBUTION OF ENGLISH GRADES.  
SCHOOL 2. FIRST YEAR.

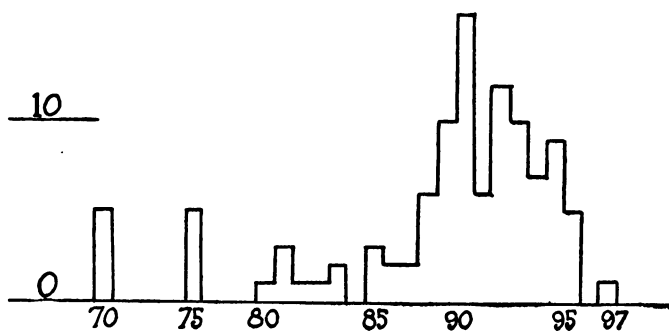


PLATE 22.  
DISTRIBUTION OF ENGLISH GRADES.  
SCHOOL 2. SECOND YEAR.

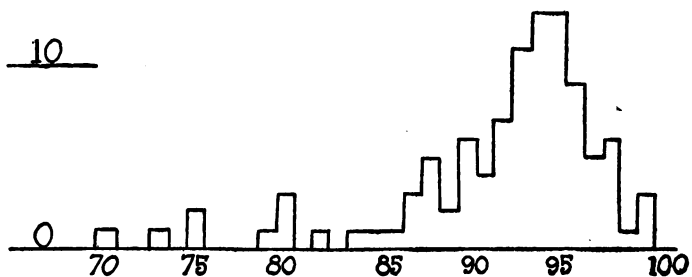


PLATE 23.  
DISTRIBUTION OF GRADES IN ENGLISH.  
SCHOOL 2. THIRD YEAR.

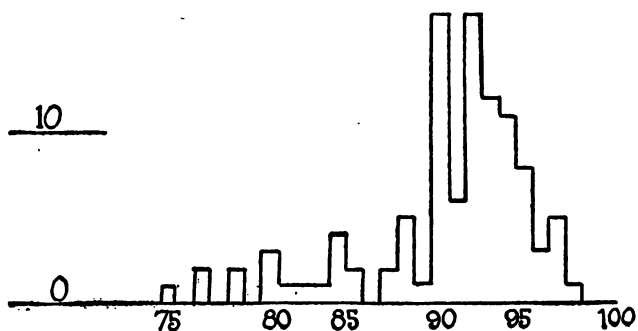
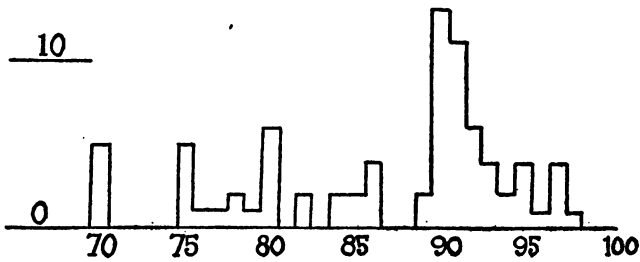
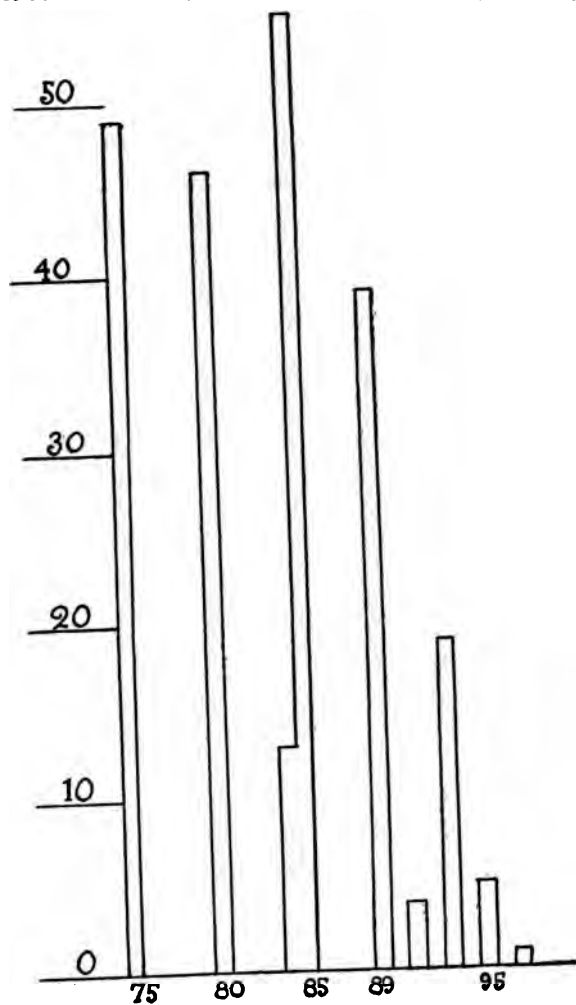




PLATE 24.  
 DISTRIBUTION OF GRADES IN ENGLISH.  
 SCHOOL 2. FOURTH YEAR.



**PLATE 25.**  
**DISTRIBUTION OF GRADES IN ENGLISH. SCHOOL 3.**



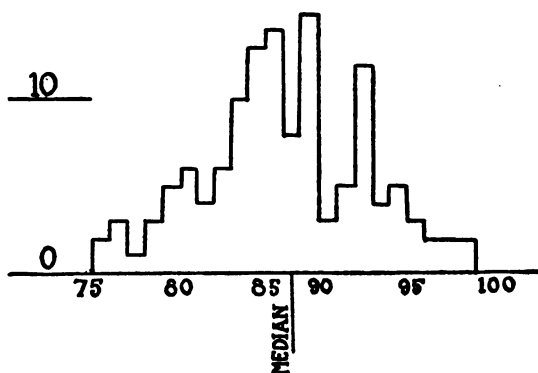
The salient features of these different curves are as follows:

School 1.....	Skewed to left decidedly.
School 2—1 yr.....	Skewed to the right.
2 yr.....	Skewed to right.
3 yr.....	Skewed to right decidedly.
4 yr.....	Skewed to right.
School 3.....	Skewed to right.
School 4.....	Skewed to right.
School 5.....	Skewed to left.
School 6.....	Skewed to right.
School 7.....	Trinodal.
School 8.....	Skewed to right.
School 9.....	Binodal.

None of the curves, then, approaches the normal. There seems to be a decided tendency to grade liberally in this subject, as is indicated by the fact that many of the curves are skewed to the right. In several of the schools certain grades are used over-frequently, while others are not used at all. We have noted that in School 1 the curve is skewed to the left in a decided way. This school happens to be in the shadow of a great university which treats its students in English in this same manner, so that this distribution is, according to the testimony of teachers in the high school, a reflection of the attitude of this university.

In three of these schools we have grades enough to get a good idea of the distribution for different years. These curves are shown in Plates 26-33.

PLATE 26.  
DISTRIBUTION OF GRADES IN ENGLISH.  
SCHOOL 1. FIRST YEAR.



**PLATE 27.**  
**DISTRIBUTION OF GRADES IN ENGLISH**  
**SCHOOL 1 SECOND YEAR .**

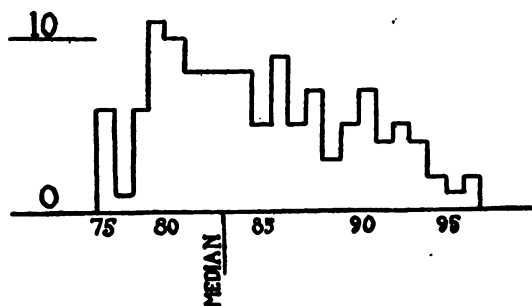


PLATE 28.  
DISTRIBUTION OF GRADES IN ENGLISH.  
SCHOOL 1. THIRD YEAR.



PLATE 29.  
DISTRIBUTION OF GRADES IN ENGLISH  
SCHOOL 1. FOURTH YEAR.

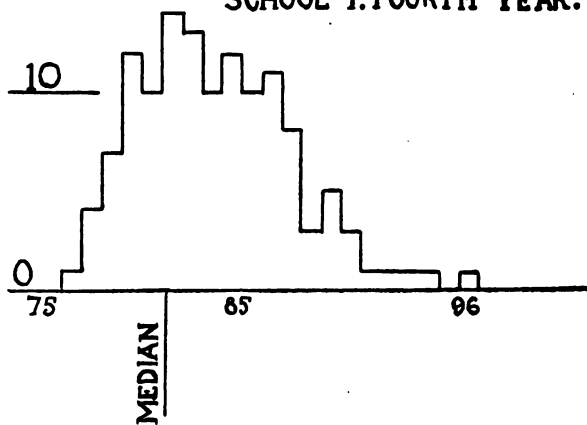


PLATE 30.  
DISTRIBUTION OF GRADES IN ENGLISH.  
SCHOOL 3. FIRST YEAR.

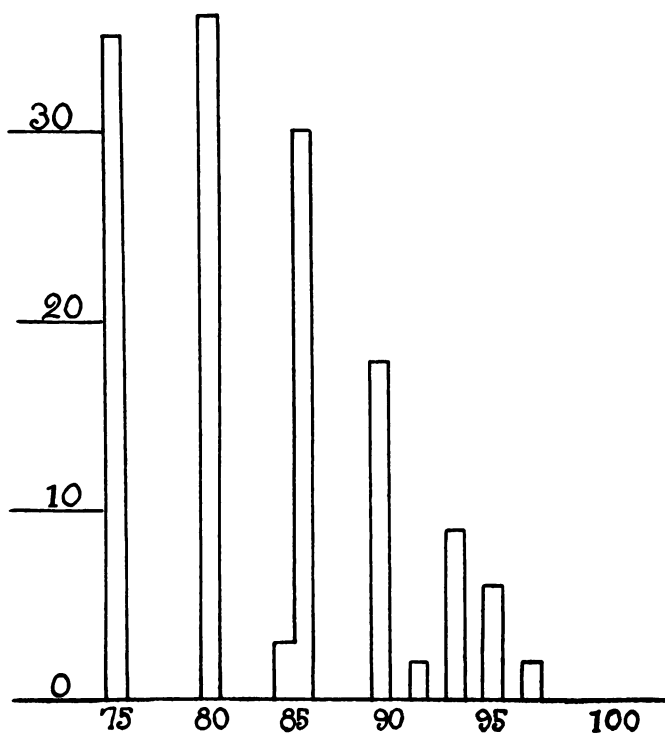




PLATE 31  
DISTRIBUTION OF GRADES IN  
ENGLISH. SCHOOL 3. SECOND YEAR.

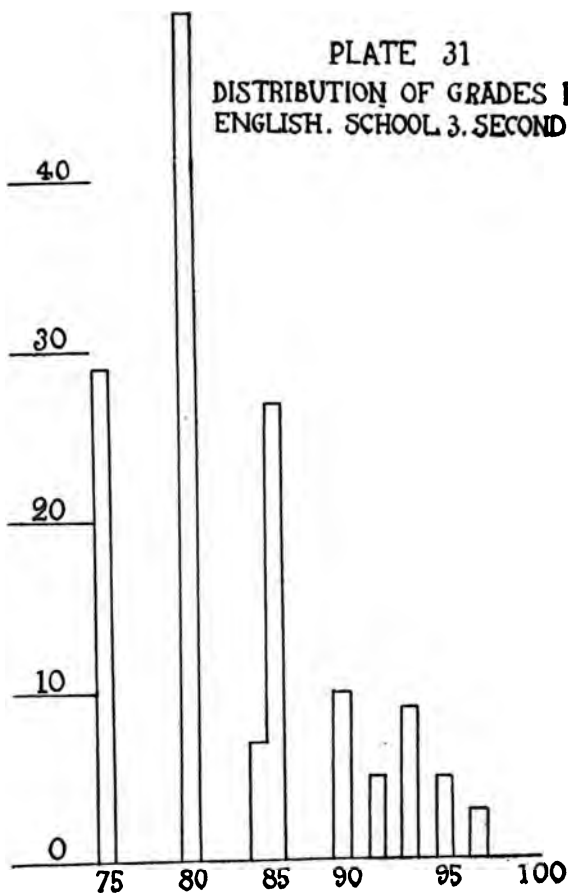


PLATE 32.  
DISTRIBUTION OF GRADES IN ENGLISH.  
SCHOOL 3. THIRD YEAR.

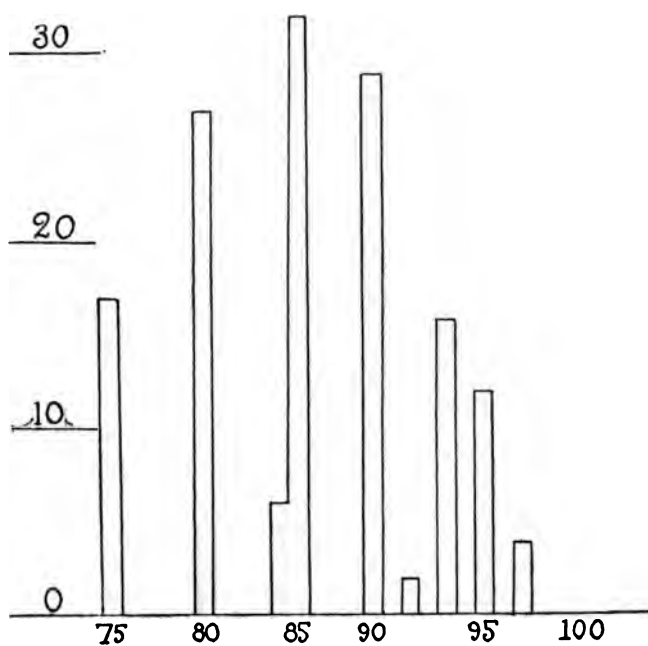
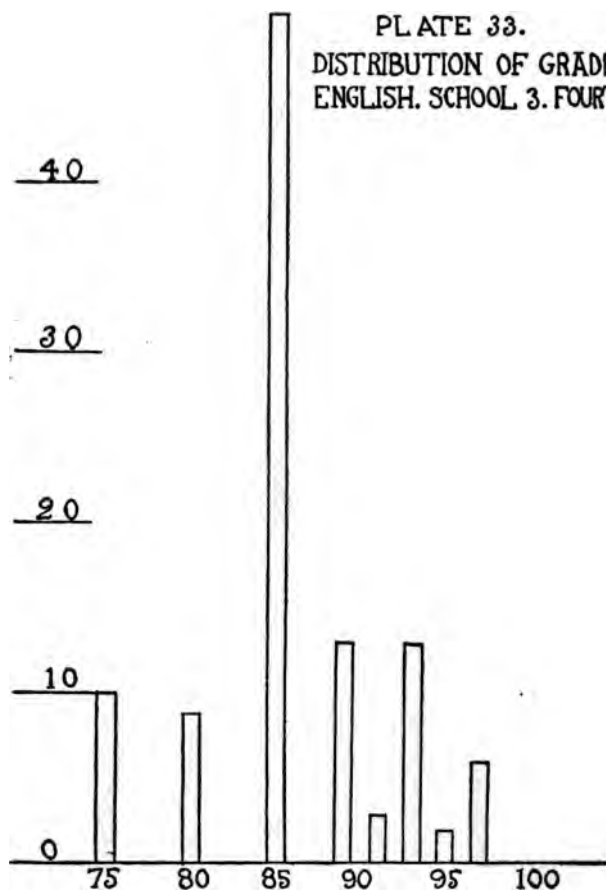


PLATE 33.  
DISTRIBUTION OF GRADES IN  
ENGLISH. SCHOOL 3. FOURTH YEAR.



The following features may be noted in these curves:

- School 1—1 yr..... Fairly normal.  
2 yr..... Skewed to left.  
3 yr..... Skewed to left.  
4 yr..... Skewed to left decidedly.
- School 2—See preceding table.
- School 3—1 yr..... Skewed to left.  
2 yr..... Skewed to left.  
3 yr..... Fairly normal.  
4 yr..... Very erratic.

The first fact which attracts our attention is the totally different distributions for the different years in the same schools. This may be accounted for in some degree by the change of subject-matter, but still it is hard to see how there can be an occasion for such a change as occurs from the third to the fourth year in School 3. In fact, it is almost impossible to find any excuse for such a distribution as occurs in the fourth year. No attempt is made at discrimination. Eighty-five is an average grade, and practically the whole class is given this grade.

All the departments have been gone over in this manner, and from this we get the following conclusions:

If we compare different schools, it can be said that they fall into four classes. First, there are those schools which tend to mark everybody high all the way through. Second, there are those which tend to mark everybody low. Third, there is at least one school in which there is a fairly normal distribution most of the way through. Fourth, there are those schools in which there seems to be no constant tendency.

It would be interesting to know what causes a certain type of grading to appear in all the departments

of a school, since it is certain that it does not come from any scientific study of the problem. In the case of School 2 there is no question but that it comes from an administrative device, and it would seem that other types might arise from similar causes.

If the same department in different schools or different departments in the same school are compared, very decided differences are discovered. In fact, it is most difficult to find any common law or principle, except in a very few cases.

If the question is asked: Which department shows the widest variations in its distribution of grades? it seems sure, taking into consideration the variations in different schools and the variations in the same schools from year to year, that this is the English department.

The conclusion which results from this portion of our study is: *The variations which appear in the grades of a high-school pupil are in part due to the variations which are made in the teachers' arbitrary distributions of grades from year to year or from semester to semester.*

#### *D. Different Types of Variation.*

The problem here raised is: When the grades of a class exhibit large variations from one year to another within the same subject, what is the nature of the change? Are the grades of the entire class raised or lowered, or are individual grades shifted, or are both modifications present? It is evident that different types of variation are possible.

( If the grades of a class as a whole were raised or lowered and no other change were made, the process would cause variations of all pupils in points, but

would not cause any change in positions (quintiles), because the relative position of the pupils would remain the same.

The movement of the class as a whole may be determined by the relation of total gains to total losses. For example, in School 1, total gains in English are 407; total losses, 1012. The median of the class has been shifted downward. This may be corroborated by comparing the actual distributions, Plates 26 to 29. In History, same school, however, the total gains are 202; the total losses, 200. Hence the median remains practically stationary (see Plates 34 to 37). Again, in Modern Language, the total gains are 149; the total losses, 519, so that the class as a whole is lowered. Inspection of Plates 39 to 42 shows this even more clearly: the median grade is about 88 in the first, 86 in the second, 84 in the third and slightly lower yet in the fourth year. Practically the same thing holds true in the same school in Science (Plates 43 to 47), where the median falls from about 86 to about 83.

Inspection of the data obtained from this school shows that the individual shifts are predominantly small in History and in Science, but large in Modern Languages.

In a similar way, examination of the data from other schools shows that there are several different types of variation. Most commonly the total variations of the pupils are affected in part by the fact that teachers have, whether consciously or unconsciously, altered the standard of their marking, and consequently moved the grades of the entire class either up or down. This might be interpreted to mean that the class as a whole is so much nearer to,

or farther from, perfection, or that there has been a change in teachers, but it more probably indicates the absence of scientific study of the meaning and distribution of grades.

It seems logical to suppose that a teacher in many cases thinks she is marking rigorously by marking the whole class down, when this is not true at all, for the relative position of the individuals may not be changed.

When, in addition to this shifting of the class as a whole teachers proceed to make large individual variations in the class—when, in other words, they use both kinds of variations, as is done in Modern Languages, School 1, the procedure seems to be most unreasonable. It must indicate that the course of study is poorly organized, or that the pupils are not ready for the work, or that the teacher cannot discriminate. It seems evident that this affords a case for investigation.

Another type is to vary the class as a whole to a considerable degree, and then make small individual variations. This is much more reasonable, and may sometimes be necessary.

The ideal, which is accomplished in History, School 1, and in other subjects not given here, is to keep the class as a whole stationary, and then use small individual variations. This certainly suggests a well-organized course of study; also that the pupils are ready for each advanced step, and that the teacher is accurate in her marking.

We see, then, that this lack of knowledge by teachers of the theory of grading cannot but play some part in the variations which pupils exhibit in their marks.

**PLATE 34.**  
**DISTRIBUTION OF GRADES IN HISTORY. SCHOOL 1.**

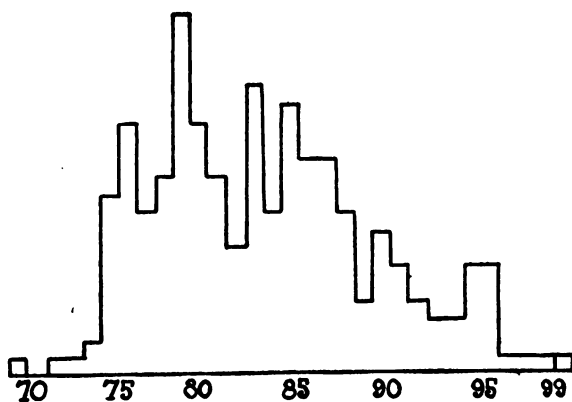




PLATE 35.  
DISTRIBUTION OF GRADES IN HISTORY.  
SCHOOL 1. SECOND YEAR.

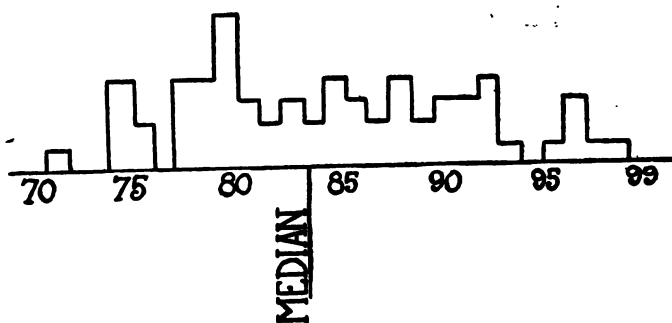


PLATE 36.  
 DISTRIBUTION OF GRADES IN HISTORY.  
 SCHOOL 1. THIRD YEAR.

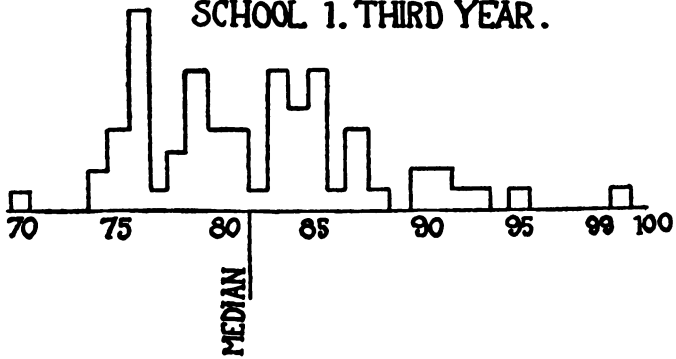


PLATE 37.  
DISTRIBUTION OF GRADES IN HISTORY.  
SCHOOL 1. FOURTH YEAR.

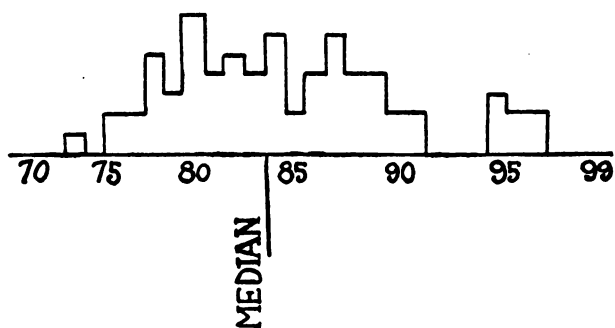


PLATE 38.

DISTRIBUTION OF GRADES IN MODERN LANGUAGE.

SCHOOL 1.

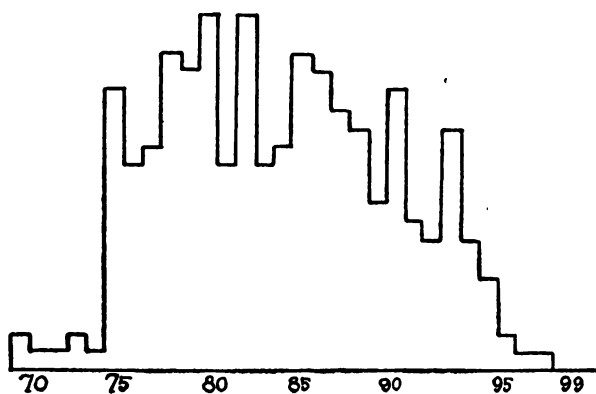


PLATE 39.  
 DISTRIBUTION OF GRADES IN MODERN LANGUAGE.  
 SCHOOL 1. FIRST YEAR.

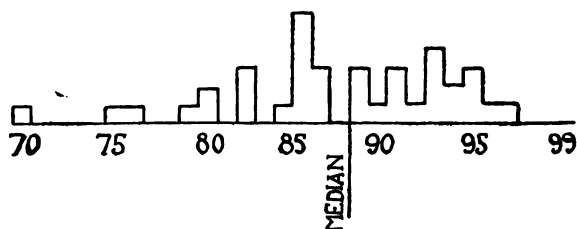
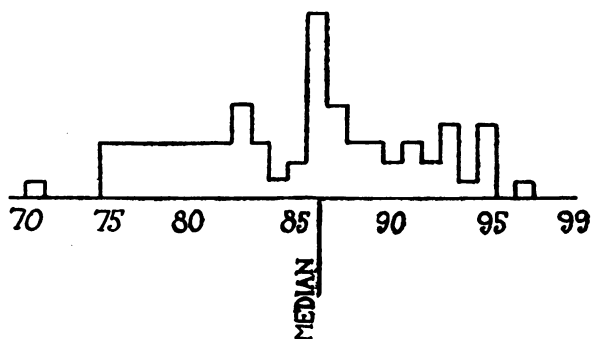


PLATE 40.  
DISTRIBUTION OF GRADES IN MODERN LANGUAGE.  
SCHOOL 1. SECOND YEAR.



**PLATE 41.**  
**DISTRIBUTION OF GRADES IN MODERN LANGUAGE.**  
**SCHOOL 1. THIRD YEAR.**

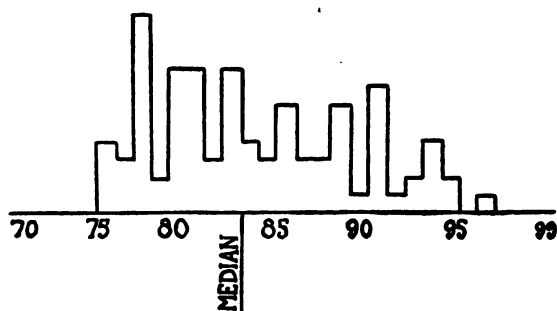


PLATE 42.  
DISTRIBUTION OF GRADES IN MODERN LANGUAGE.  
SCHOOL 1. FOURTH YEAR.

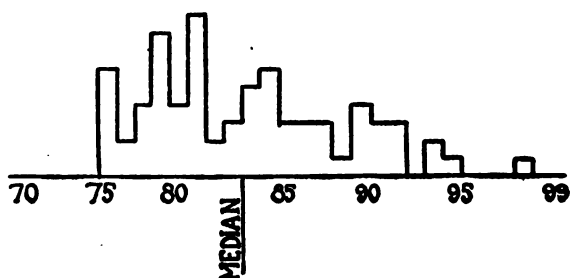




PLATE 43.  
DISTRIBUTION OF GRADES IN SCIENCE. SCHOOL 1.

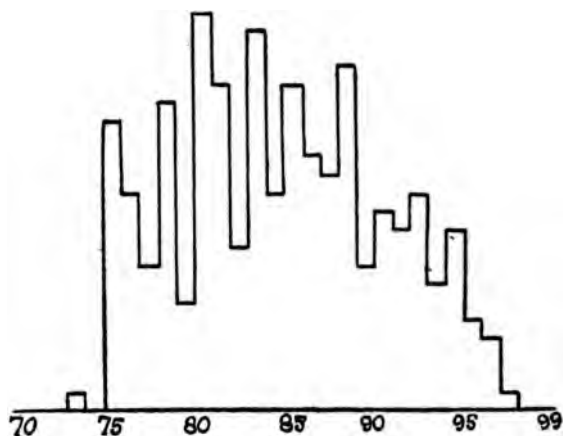


PLATE 44.  
DISTRIBUTION OF GRADES IN SCIENCE.  
SCHOOL 1. FIRST YEAR.

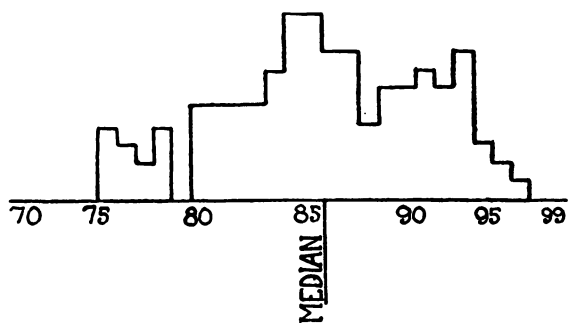


PLATE 45.  
DISTRIBUTION OF GRADES IN SCIENCE.  
SCHOOL 1. SECOND YEAR.

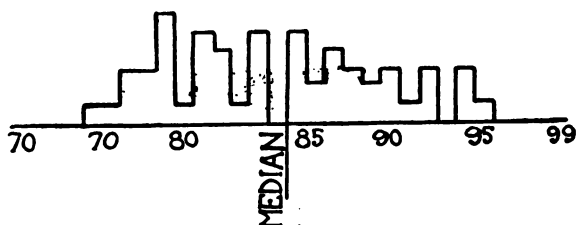


PLATE 46.  
DISTRIBUTION OF GRADES IN SCIENCE .  
SCHOOL 1. THIRD YEAR.

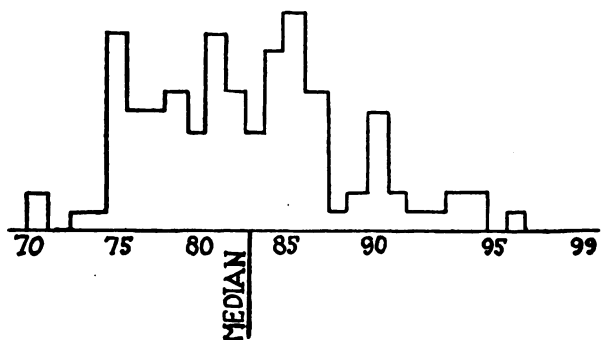
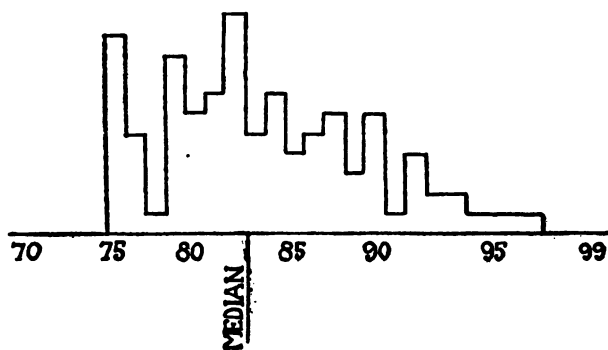


PLATE 47.  
DISTRIBUTION OF GRADES IN SCIENCE.  
SCHOOL 1. FOURTH YEAR.



*E. Variation in the Grading of the Same Examination Papers by Different Teachers.*

In order to get information as to the way in which different teachers undertake the work of grading examination papers, inquiries were made as to their methods, and an experiment was conducted in the actual marking of sets of papers by different teachers.

To illustrate one source of variability in grades, we may, then, first cite typical statements given by different teachers of their method of grading. One teacher states that she takes 100 as an absolute standard and grades each pupil by that standard. If there are ten questions, each answer is graded on this scale. While this method would work well in mathematics, it would hardly apply so well in English. That is, the less exact a subject is, the harder it would be to apply this principle.

A second teacher reports that she takes one of the best pupils in the class as a standard and grades the class about this single individual. This sort of procedure is sure to lead to variations of the whole class, for if this one pupil varies the whole class will shift. If a different individual is selected at each examination, then there is sure to be considerable variation in the whole class.

A third teacher says that in her work in English she keeps a record of all the improvements which a pupil makes and at the end of a semester gives out grades which indicate the amount of improvement made. This, of course, requires that each individual be given a grade at the beginning of each semester,

and would require pretty accurate judgment. At any rate, there is room for plenty of variation to be made.

Another teacher states that he has a definite standard of the amount of work which each pupil should accomplish in a month or two months, and so grades a class from this standard.

This list could be much extended, for, although numerous teachers were questioned about their grading, yet each one seemed to have a different plan. This again shows clearly that the teacher enters into the variations of pupils' marks to a considerable degree, although in an unconscious manner.

Secondly, an experiment in grading was arranged in this wise: Two sets of examination papers were procured from an Indiana high school, one set in Senior English, the other in Solid Geometry. The papers were accompanied by the grades given by the Indiana teachers. The papers were then graded again by a number of experienced teachers, who were asked to follow the following directions:

Enclosed is a set of examination papers in mathematics (or English) from a high school in Southern Indiana.

Each paper is numbered in the left-hand margin.

Attached to this sheet is a set of the questions used, with a paper with numbers in the left-hand margin. This last sheet is numbered 100.

You will please grade these papers just as you would a set of your own papers, except that you will please put no marks of any kind on the papers themselves.

Please place your grades on Sheet 100, opposite the number which corresponds to the number on the particular paper. If your grades are in letters, please transfer them to per cents and place these grades on the line with their corresponding grade in letters.

The passing mark is 70.

On the following pages the results obtained are

given. The letters at the top of the columns indicate the different markers. *A* in each case is the original teacher. The average (second) column indicates the average of the six grades for each pupil. The variations are counted from this average.

TABLE 34.

*Mathematics.*

Pupils.	Av.	A.	B.	C.	D.	E.	F.	1st Var.	2d Var.	3d Var.	4th Var.	5th Var.	6th Var.
1.....	66.5	67	69	54	55	78	76	0.5	2.5	12.5	11.5	11.5	9.5
2.....	77.3	80	70	72	80	80	82	2.7	7.3	5.3	2.7	2.7	4.7
3.....	86.3	90	91	79	87	87	84	3.7	4.7	6.7	0.7	0.7	2.3
4.....	28.5	53	25	18	30	30	15	24.5	3.5	10.5	1.5	1.5	13.5
5.....	45.5	63	62	30	40	60	18	17.5	16.5	16.5	5.5	14.5	17.5
6.....	57.0	62	58	55	55	60	52	5.0	1.0	2.0	2.0	3.0	5.0
7.....	76.6	84	79	80	77	85	55	7.4	2.4	3.4	0.4	8.4	21.5
8.....	83.5	87	92	70	75	89	88	3.5	8.5	13.5	8.5	5.5	4.5
9.....	67.5	85	75	55	67	73	50	17.5	7.5	12.5	0.5	5.5	17.5
10.....	78.8	80	89	80	75	79	70	1.2	10.2	1.2	3.8	0.2	8.8
11.....	44.5	52	42	53	40	50	30	7.5	1.5	8.5	4.5	5.5	14.5
Totals....		866	814	676	721	831	638						
Averages.		78.7	74.0	61.4	65.5	75.5	58.0						

TABLE 35.

*English.*

Pupils.	Av.	A.	B.	C.	D.	E.	F.	1st Var.	2d Var.	3d Var.	4th Var.	5th Var.	6th Var.
1.....	59.3	93	64	70	39	55	55	13.7	4.7	10.7	20.0	4.3	4.3
2.....	82.5	87	92	87	67	70	92	4.5	9.5	4.5	15.5	12.5	9.5
3.....	82.7	83	88	81	59	75	90	0.3	5.3	1.7	23.7	7.7	7.3
4.....	77.8	74	85	72	53	65	88	3.8	7.2	5.8	24.8	12.8	10.2
5.....	75.6	74	82	80	58	75	65	1.6	6.4	4.4	17.6	0.6	9.4
6.....	66.8	72	78	75	38	60	78	5.2	11.2	8.2	28.8	6.8	11.2
7.....	71.2	79	89	71	45	65	78	7.8	17.8	0.2	26.2	6.2	6.8
8.....	79.3	83	84	81	61	75	92	3.7	4.7	1.7	18.3	4.3	12.7
9.....	79.3	83	92	86	57	80	78	3.7	12.7	6.7	22.3	0.7	1.3
10.....	77.1	78	86	83	63	75	77	0.9	8.9	5.9	14.1	2.1	0.1
11.....	87.0	88	81	82	53	70	78	1.0	6.0	5.0	34.0	17.0	9.0
12.....	85.3	91	89	85	73	80	94	5.7	3.7	0.3	12.3	5.3	3.7
13.....	68.3	70	80	72	43	60	85	1.7	11.7	3.7	25.3	8.3	16.7
14.....	76.5	83	87	84	60	75	70	6.5	10.5	7.5	16.5	1.5	6.5
15.....	76.1	85	79	84	56	65	88	8.9	2.9	7.9	20.1	11.1	11.9
16.....	74.0	74	81	78	53	70	88	0.0	7.0	4.0	21.0	4.0	14.0
17.....	65.3	71	83	71	43	65	60	5.7	17.7	5.7	22.3	0.3	5.3
18.....	62.8	82	81	76	33	55	50	19.2	18.2	13.2	29.8	7.8	12.8
19.....	77.8	81	90	73	60	75	78	13.2	12.2	4.8	17.8	2.8	0.2
20.....	79.8	85	84	78	67	80	85	6.2	5.2	1.8	12.8	0.2	6.2
Totals....		1606	1675	1569	1081	1400	1589						
Averages.		80.3	83.7	78.5	54.0	70.0	79.5						



The large differences apparent in the grading of the different readers (not particularly the final averages at the foot) is certainly very significant, and probably sheds a greater light upon the problem at hand than any other point taken up in the investigation. These readers are all highly trained experts in high-school work (not college teachers), so that if the grading of any one stood alone, no one would question the validity of the grades.

In the English grades the two readers who vary most from each other are teachers in the same department of a large and well-organized high school. It might seem possible to account for the large differences in grades of the English papers by the fact that this is not an exact subject, and that the personal opinion of the teacher must, therefore, enter into the grading, but a survey of the grades in mathematics, which is the most exact science, shows the differences here to be on a par with those in English. It is necessary, accordingly, to make some explanation for the variations in the grading other than the differences in the subject-matter. The only plausible explanation is that teachers' marks are essentially unreliable./

This point has been brought out in the distribution of grades for different schools, as well as for different departments in the same school. It has also been made apparent in our examination of the different types of variations, and it is now clearly evident in this grading of the same papers by different teachers.

This does not mean that teachers do not do their grading thoughtfully, carefully and honestly, but rather that there is urgent need of a standard which

can be used by different schools, different departments and by different teachers. If it is possible to score an ear of corn accurately by means of a scientific scorecard, it ought to be possible to score a set of examination papers with reasonable accuracy.

It seems evident that one of the next great steps in educational work will be the introduction of such methods of *educational measurement* as will ensure definite standards and a scientific basis for every phase of school work.



## **GENERAL CONCLUSIONS FROM THE STUDY.**

1. High-school students exhibit a much smaller variation in their marks and grades than is usually thought.

2. There is only a small group of pupils in the high school whose work is characterized by great variability.

3. The variations which they do exhibit are due to a number of causes, and not simply to instability of the pupils.

4. Some of the causes usually given for variations, such as home conditions, deportment, application, social tendencies, etc., play very little part in the variations.

5. The variations which are termed losses are largely balanced by gains.

6. The unreliability of teachers' gradings is one of the chief causes for the variations.

7. A scientific study by teachers of marking systems and of the distribution of grades would do much to decrease the variations.



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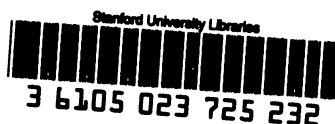
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